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WORLD RICE STUDY:
Disappearance, Production, and Price Relationships Used to Develop the Model

U.S. DEPARTMENT OF AGRICULTURE
ECONOMIC RESEARCH SERVICE
IN COOPERATION WITH THE AGRICULTURAL
EXPERIMENT STATIONS OF ARKANSAS AND TEXAS

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WORLD RICE STUDY: Disappearance, Production, and Price Relationships Used to Develop the Model. By Warren R. Grant, Troy Mullins, and William F. Morrison. Economic Research Service, U.S. Department of Agriculture. ERS-608.

ABSTRACT

Equations used to develop a world rice model are presented as background for other reports discussing the results of the model. The equations represent national and regional production and disappearance functions and price relationships within and between countries.

Washington, D.C. 20250 October 1975

PREFACE

This report is part of an informal effort between the Department of Agricultural Economics and Rural Sociology, University of Arkansas; Department of Agricultural Economics, Texas A&M University; and the Economic Research Service (ERS), U.S. Department of Agriculture. The task force working on the study is composed of:

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WORLD RICE STUDY: DISAPPEARANCE, PRODUCTION, AND PRICE RELATIONSHIPS USED TO DEVELOP THE MODEL

by
Warren R. Grant, Troy Mullins, and William R. Morrison 1/

Introduction

The United States exports about two-thirds of its rice production. Thus, it is essential that the rice industry and formulators of Government policy be familiar with the interaction effects of changes in world demand, supply, trade, and prices.

This report presents the basic sets of equations used to develop a world rice model. Historical, current, and prospective data on world supply, demand, trade, and prices of rice are used in an analytical framework to evaluate the effects of alternative policies on the United States and the world rice market. The model focuses on the impact that changes in world conditions and policies have on U.S. rice program costs and prices.

The material contained in this report is intended as background information for other reports dealing with the world rice model. These reports include a user's manual for the computer programs of the model, a compilation of the data used to develop the equations in this report, and an analysis of the world rice economy.

Procedure

The basic conceptual framework for analysis is a set of national and regional production and disappearance functions (equation sets) with price relationships to reflect those existing within and between countries. Solution of the equation sets is with a linear programming algorithm. The world rice model is principally a national-level behavioral model.

The world rice economy was divided into 38 countries or regions. The United States was divided into two regions--one for production of long-medium grain rice, and the other for short grain rice. A set of equations for estimating production, disappearance, and external and internal price relationships was developed for each country or region using ordinary least squares and two-stage least squares regression techniques.

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"Black market" rates quoted in Pick's Currency Yearbook were used to convert all price and income data to current U.S. dollar values. All rice quantities are expressed as milled rice equivalents. Metric units were used for area, yield, production, trade, and disappearance data. Disappearance is defined as production minus exports plus imports and stock changes (when stock data were available).

The estimated equations attempt to explain production, disappearance, and price relationships with available data. For some countries, data limitations necessitated using proxy variables which resulted in equations that are not structural and making subjective estimates for some coefficients. For most countries, the production and disappearance equations were estimated from aggregate data. For some countries, however, subaggregate data were available, and subaggregate equations were estimated. They were added to form the aggregate equation needed for the model, but the subaggregate equations are also presented for the interested reader. The equations are linear because of the linear assumption of the model. However, on some exogenous variables, quadratic terms are used. These were collapsed with the intercept by the computer before entering the linear programming algorithm. Identities and restraints are included with each set of country equations to make that set comparable to the model. Market clearing equations that allow trade flows in the model are not presented here. A description of these transfer functions will be included in the report on the user's manual.

Country Equations

Because of size restraints of the model and time constraints on the project, sets of equations were not estimated for every country that produced or consumed rice. However, equation sets were estimated for the major rice-producing countries. The remaining countries were grouped into related subgroups before the equation sets were estimated. The countries and regions are presented in table 1. The estimated equations, together with a description of variables and charts showing actual and estimated trends for each country or region, follow in alphabetical order. The t values (in parentheses under each coefficient), multiple correlation coefficients (R^2), standard error of estimate, and time period are presented for each estimated equation when available.

Table 1. The 38 Countries and Regions Used in the World Rice Model

Area, Country, and Rice Type	
ASIA	WESTERN HEMISPHERE
Bangladesh	Brazil
Burma	Canada
China and Others 1/	Cuba
Hong Kong	USA Short Grain
India	USA Long Grain
Indonesia	Western Hemis. Exporters 5/
Japan	Western Hemis. Importers 6/
Khmer Republic-Laos	
Malaysia	AFRICA
Near East, Short Grain 2/	Egypt
Near East, Long Grain 3/	Malagasy Republic
Nepal	South Africa
Pakistan	Africa Importers (Other Africa) 7/
Philippines	
Singapore	EUROPE
Republic of Korea	European Economic Community 8/
Republic of Vietnam	Spain and Greece
Sri Lanka	European Importers 9/
Taiwan	Russia and Others 10/
Thailand	Italy
OCEANIA	
Australia	
Oceania 4/	

1/ China and Others - China, North Korea, North Vietnam, and Macao.
2/ Near East, Short Grain - Cyprus, Israel, Jordan, Lebanon, Syria, and Turkey.
3/ Near East, Long Grain - Afghanistan, Bahrain, Iran, Iraq, Kuwait, Masqat, Oman, Qatar, Saudi Arabia, Southern Yemen, Trucial States, and Yemen.
4/ Oceania - Cook Island, Ellice Islands, Fiji, French Polynesia, Gilbert Islands, Guam, Maldive Islands, Nauru, Niue Island, New Caledonia, New Guinea, New Hebrides, New Zealand, Norfolk Island, Papua, Portuguese Timor, Ryukyu, Solomon Islands, Tonga, and Western Samoa.
5/ Western Hemisphere Exporters - El Salvador, Argentina, Colombia, Ecuador, Guyana, Surinam, Uruguay, Venezuela, and Guatemala.
6/ Western Hemisphere Importers - Costa Rica, Honduras, Nicaragua, Mexico, Peru, British Honduras, Chile, Bolivia, Trinidad, Tobago, Netherlands Antilles, Leeward and Windward Islands, Panama, Bahama, Barbados, Dominican Republic, French West Indies, and Jamaica.
7/ Africa Importers (Other Africa) - All of Africa except Egypt, Malagasy Republic, and South Africa.
8/ European Economic Community - Belgium, Luxembourg, France, West Germany, Netherlands, United Kingdom, Ireland, and Denmark.
9/ European Importers - Austria, Switzerland, Portugal, Sweden, Norway, Finland, and Iceland.
10/ Russia and Others - Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, Russia, and Yugoslavia.

AFRICA, OTHER NET IMPORTERS

I. Disappearance

1. $QDD = 66. - 11.0105PAFIDFAR + 40.9162T$
   (1.56) (1.81)

   $R^2 = .30$ S = 155.37 Data = 1960-70

II. Production

1. $QS = - 546.38 + 8.575PAFISFAR + 2.100YIELD$
   (2.74) (2.86)

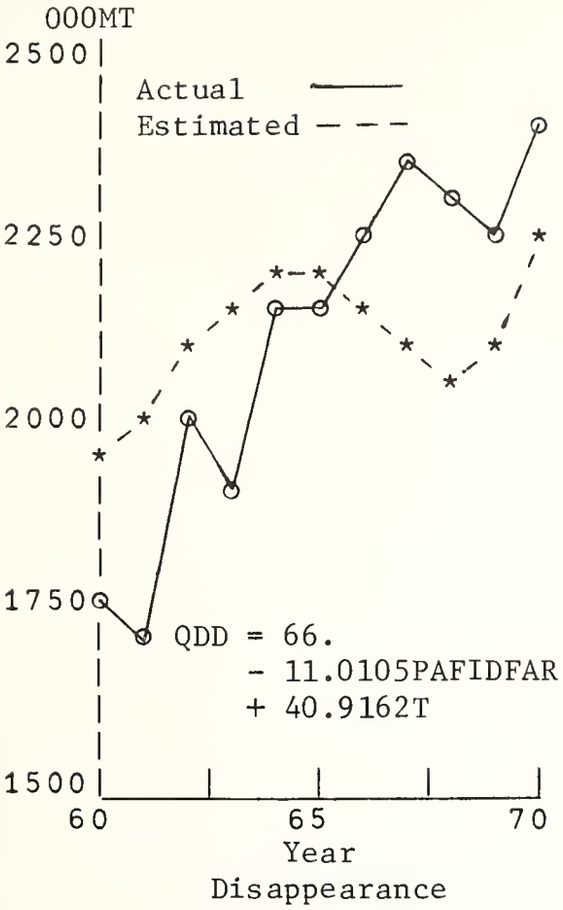
   $R^2 = .73$ S = 99.28 Data = 1960-70

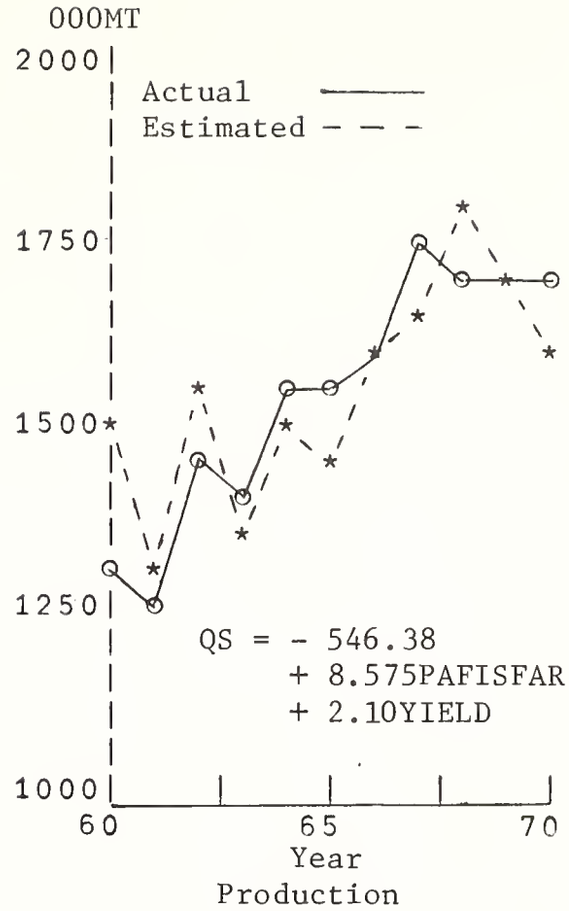
III. Price Relationships

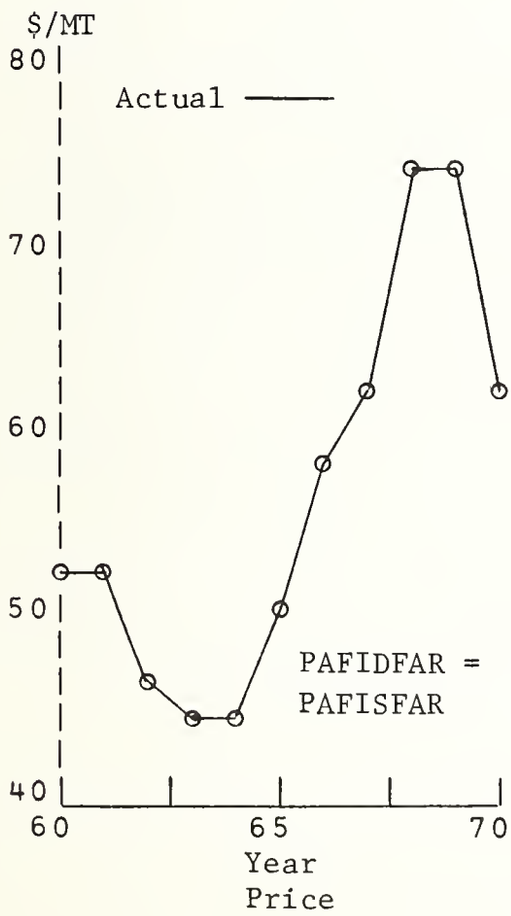
1. PAFIDFAR = PAFISFAR

2. PAFISFAR = PMRADFAR

Where:
- QDD = Domestic disappearance in thousand metric ton milled rice
- QS = Domestic production in thousand metric ton milled rice
- PAFIDFAR = Low quality farm price, U.S. dollars per metric ton
- PAFISFAR = Low quality farm price, U.S. dollars per metric ton
- PMRADFAR = Low quality farm price in Malagasy Republic, U.S. dollars per metric ton
- T = Years, 1960 = 60
- YIELD = Per hectare yield in kilograms







AFRICA, OTHER NET IMPORTERS

AUSTRALIA

I. Disappearance

1. $QDD = [3.8366 - \underset{(3.80)}{0.0184}PAUSDFAR]POP$

$R^2 = .83$ S = .06 Data = 1966-70

II. Production

1. $QS = [-1.0766 + \underset{(.77)}{.01969}PAUSSFAR + \underset{(2.00)}{.06361}T]HA\ RI$

$R^2 = .36$ S = 333.07 Data = 1960-70

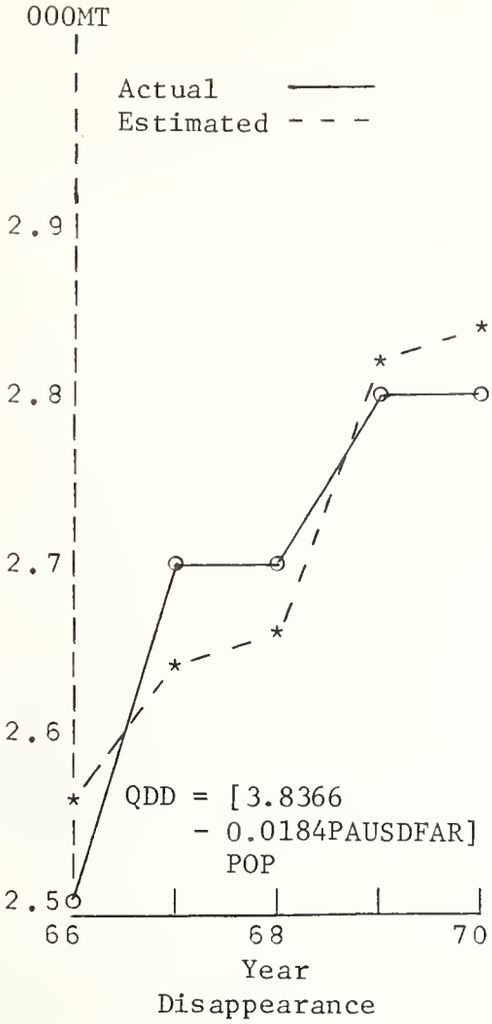
III. Price Relationships

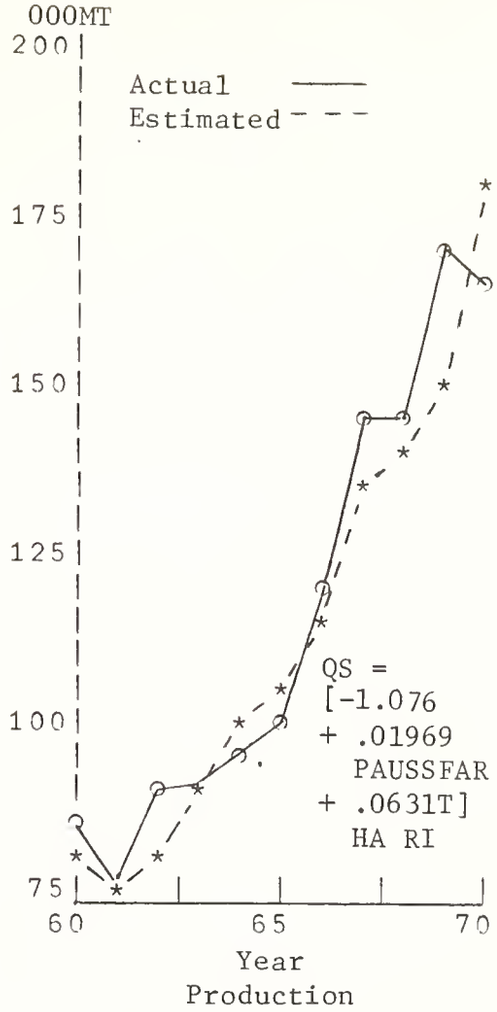
1. PAUSDFAR = PAUSSFAR

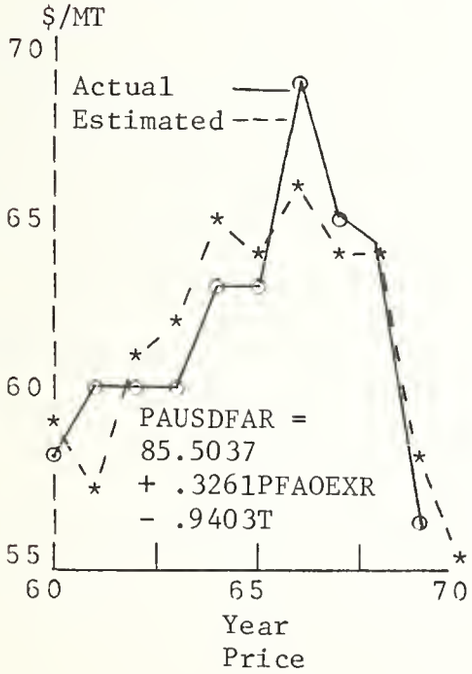
2. $PAUSDFAR = 85.5037 + \underset{(5.21)}{.3261}PFAOEXR - \underset{(3.47)}{.9403}T$

$R^2 = .77$ S = 2.12 Data = 1960-70

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PAUSDFAR = Low quality farm price, U.S. dollars per metric ton
- PAUSSFAR = Low quality farm price, U.S. dollars per metric ton
- PFAOEXR = FAO round grain price index, 1957-59 = 100
- POP = Midyear population in millions
- T = Years, 1960 = 60
- HA RI = Area in rice, thousand hectares


000MT
Actual
Estimated
2.9
2.8
2.7
2.6
2.5
QDD = [3.8366
- 0.0184PAUSDFAR]
POP
66
68
70
Year
Disappearance


000MT
200
Actual
Estimated
175
150
125
100
75
QS =
[-1.076
+ .01969
PAUSSFAR
+ .0631T]
HA RI
60
65
70
Year
Production


$/MT
70
Actual
Estimated
65
60
55
PAUSDFAR =
85.5037
+ .3261PFAOEXR
- .9403T
60
65
70
Year
Price

AUSTRALIA

BANGLADESH

I. Disappearance

1. QDD = 123.72 - 5.807PBSHDRET + 46.775POP + .8080QS
(2.16) (3.46) (13.09)

R^2 = .99 S = 108.38 Data = 1960-70

II. Production

1. QSAMAN = [5932.6338 + 6.8733RAIN - 8.1186T]YIELD AMAN
(4.68) (1.04)

R^2 = .73 S = 77.79 Data = 1960-70

2. QSAUS = [2081.1535 + .1575PBSHSRET + 4.1072RAIN + 6.9774FERT] YIELD AUS
(.05) (1.57) (4.89)

R^2 = .89 S = 142.16 Data = 1960-70

3. QSBORO = - 109.3497 + 3.0146PBSHSRET + 5.2563HA IR + 1.7742FERT
(.75) (3.33) (.40)

R^2 = .98 S = 120.64 Data = 1960-70

4. QS = QSAMAN + QSAUS + QSBORO

III. Price Relationships

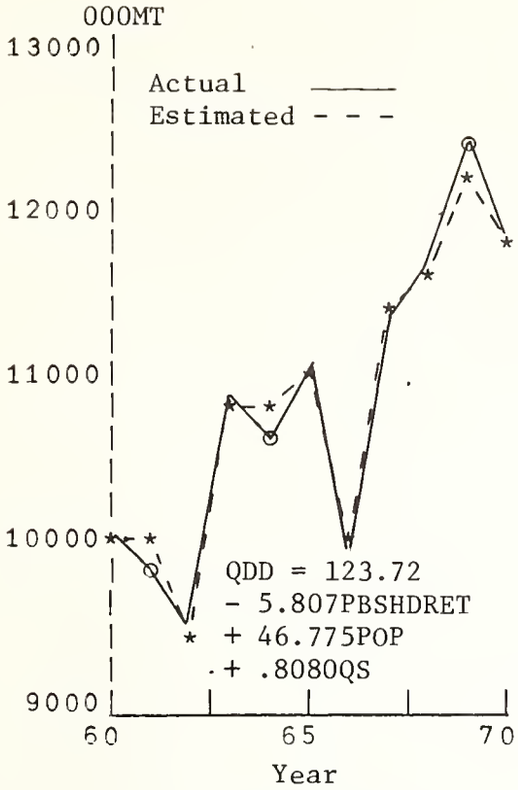
1. PBSHDRET = 3.1833 + .9125PFAOLM
(4.35)

R^2 = .68 S = 12.43 Data = 1960-70

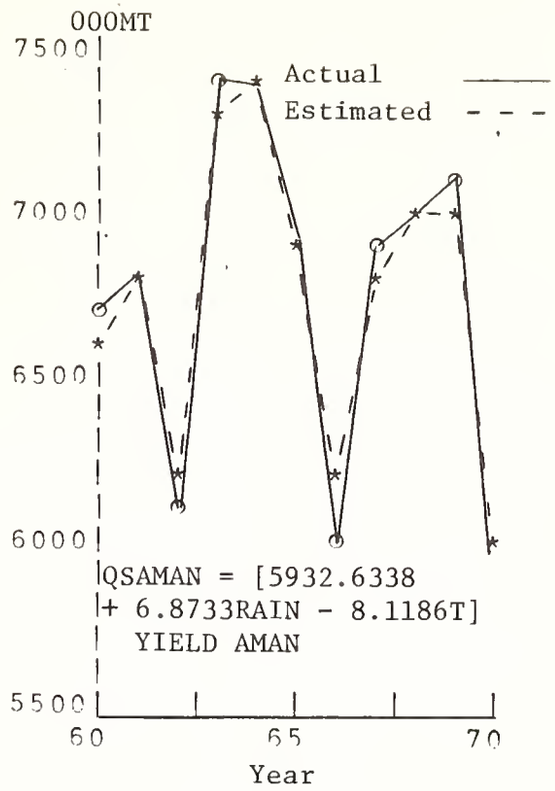
2. PBSHDRET = PBSHSRET

Where:

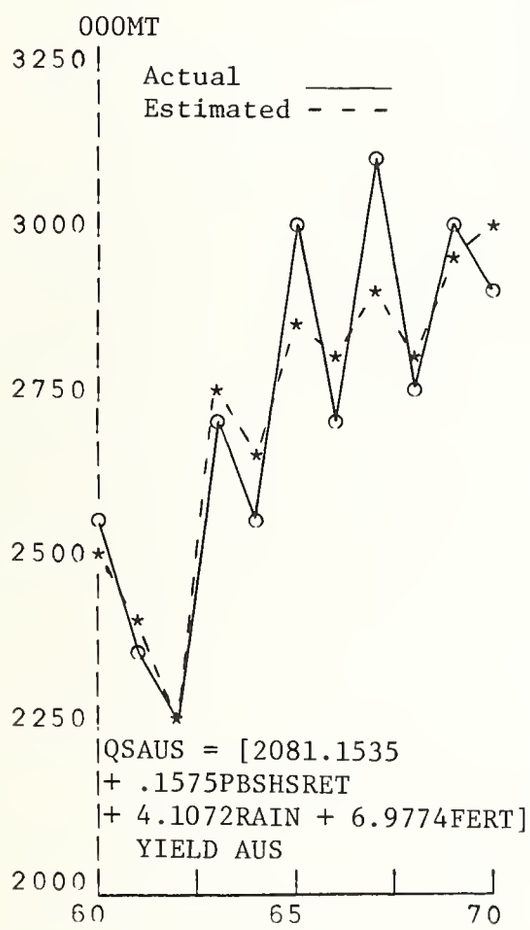
QDD	=	Domestic disappearance in thousand metric tons milled rice
QS	=	Domestic production in thousand metric tons milled rice
QSAMAM	=	Production in Aman in thousand metric tons
QSAUS	=	Production in Aus in thousand metric tons
QSBORO	=	Production in Boro in thousand metric tons
QS	=	QSAMAN + QSAUS + QSBORO
PBSHDRET	=	Low quality, retail price, U.S. dollars per metric ton
PBSHSRET	=	Low quality, retail price, U.S. dollars per metric ton
PFAOLM	=	FAO long-medium grain index, 1957-59 = 100
POP	=	Midyear population in millions
RAIN	=	Annual rainfall in Dinajpur in inches
HA IR	=	Irrigated area in rice, thousand hectares
FERT	=	Total nutrients of fertilizer used in thousand metric tons
T	=	Year, where 1960 = 60
YIELD AMAN	=	Yield in Aman season in metric tons
YIELD AUS	=	Yield in Aus season in metric tons



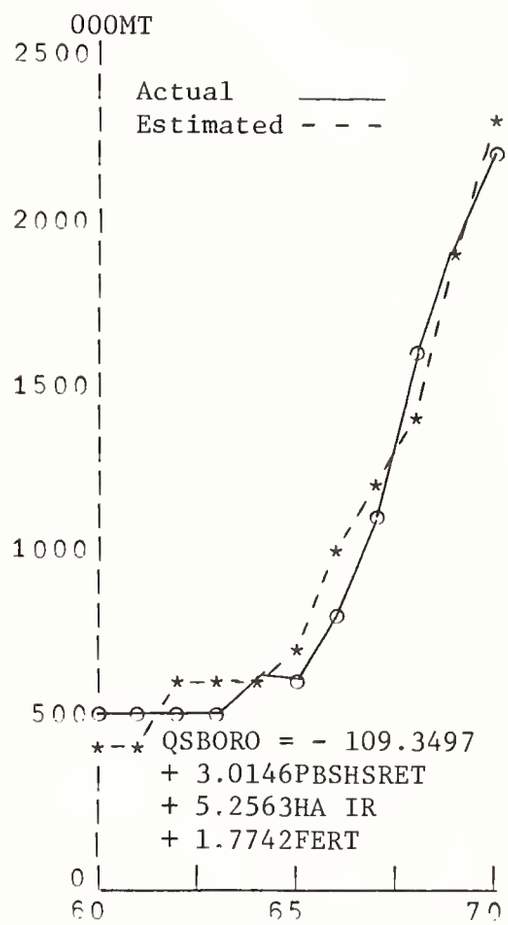
Disappearance



Production Aman

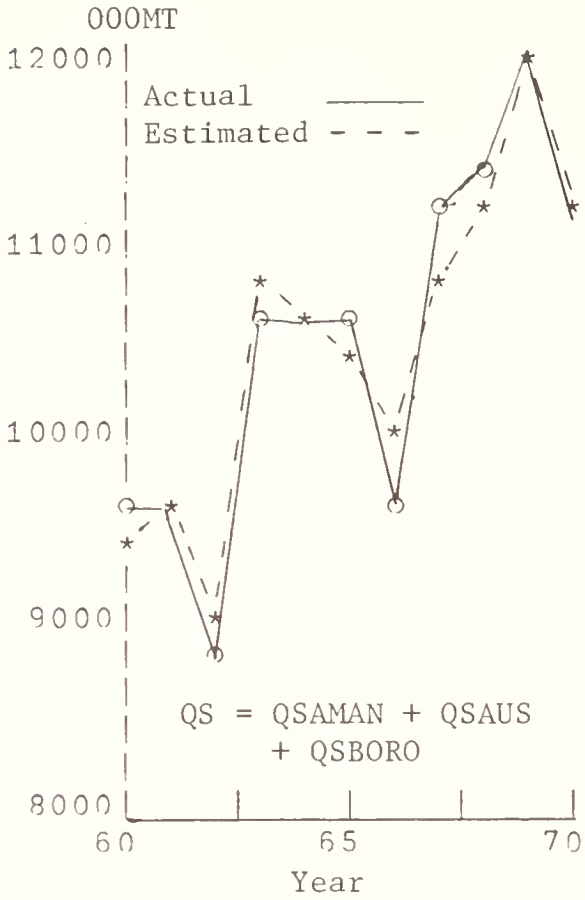


Production Aus

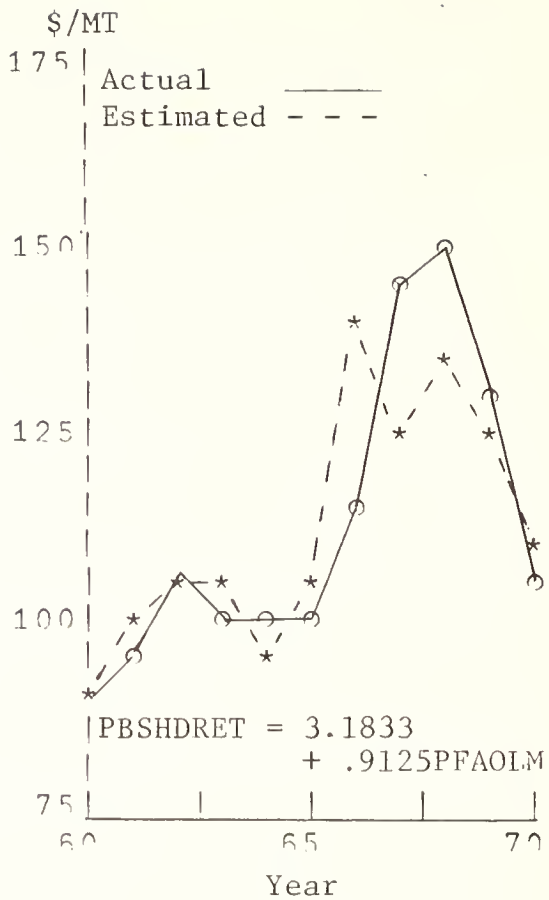


Production Boro

BANGLADESH



Total Production



Price

BANGLADESH

BRAZIL

I. Disappearance

1. QDD = [33.08 - .0242PBZLDRET + .2684PCW - .0389YPC
(.61) (2.95) (.91)
+ .0000157YPC2 + 13.0773GGP]POP
(.29) (3.92)
R^2 = .88 S = 2.25 Data = 1960-73

II. Production

1. QSI = 270.7628 + 1.2174PBZLSFAR + 165.3297GGP + .4918RAIN RG
(.43) (2.25) (1.33)
- .00023RAIN RG2 + 1.4059FERT NUTR
(1.62) (6.70)
R^2 = .91 S = 60.55 Data = 1960-72

2. QSU = - 12155.5285 + 145.2480PBZLSFAR/PCW + 4.9312YIELD UP
(.25) (4.41)
+ 164.071T
(3.83)
R^2 = .77 S = 267.68 Data = 1960-72

3. QS = QSI + QSU

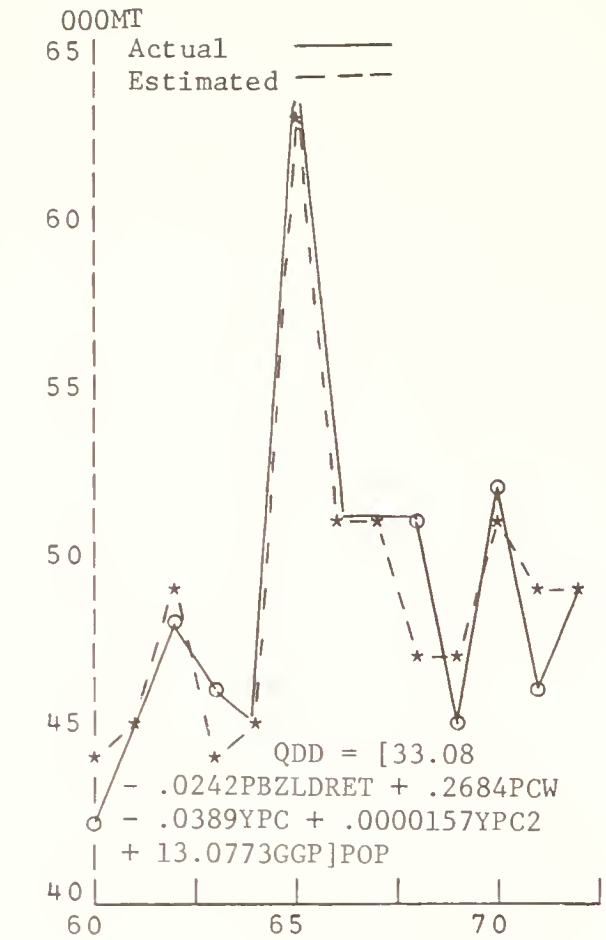
III. Price Relationships

1. PBZLSFAR = - .37 + 0.299PBZLDRET
(10.39)
R^2 = .91 S = 3.41 Data = 1960-72

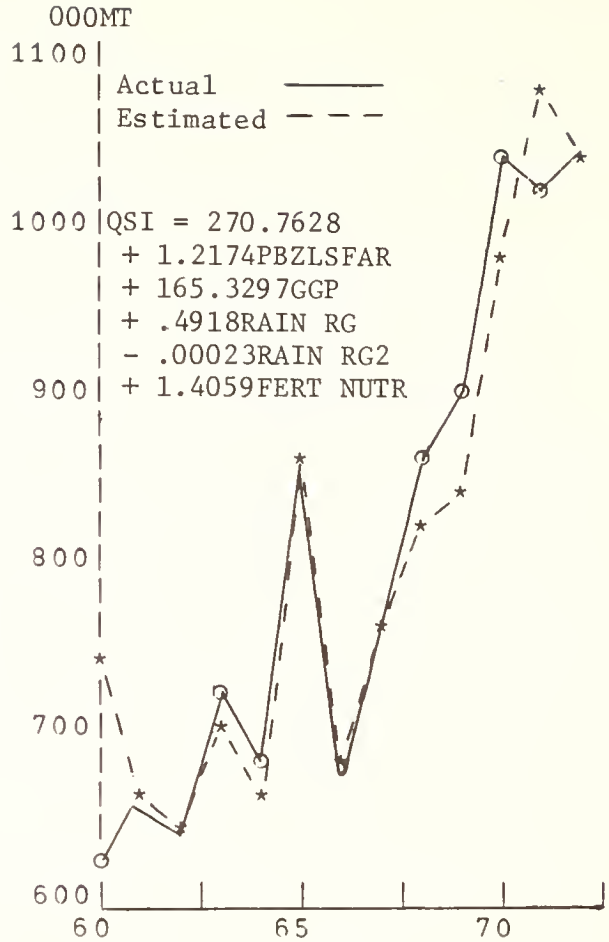
2. PBZLSFAR = FIXED

Where:

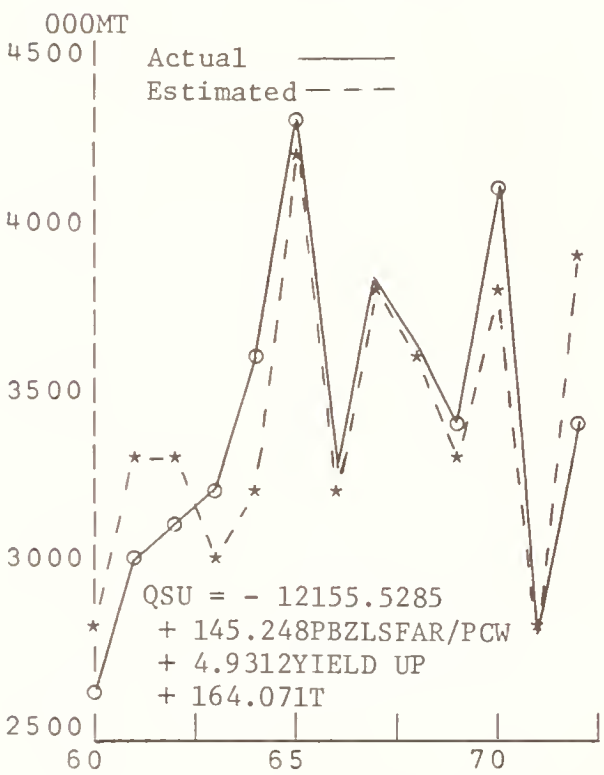
QDD	= Domestic disappearance in thousand metric tons milled rice
QS	= Domestic production in thousand metric tons milled rice
QSU	= Upland production in thousand metric tons milled rice
QSI	= Irrigated production in thousand metric tons milled rice
PBZLDRET	= Long grain retail price of rice, U.S. dollars per metric ton
PBZLSFAR	= Low quality farm price of rice, U.S. dollars per metric ton
PCW	= Wholesale price of corn, U.S. dollars per metric ton
YPC	= Income per capita, U.S. dollars
YPC2	= Income per capita, U.S. dollars, squared
GGP	= Dummy; 0 = poor, 1 = good
POP	= Midyear population in millions
RAIN RG	= Annual rainfall in millimeters, Rio Grande De Sul
RAIN RG2	= Annual rainfall in millimeters, Rio Grande De Sul, squared
FERT NUTR	= Thousand metric ton nitrogen units, all crops
T	= Year, 1960 = 60
YIELD UP	= Upland yield, kilograms per hectare
PBZLSFAR/PCW	= Ratio between long grain retail price of rice and wholesale price of corn
QS	= QSI + QSU



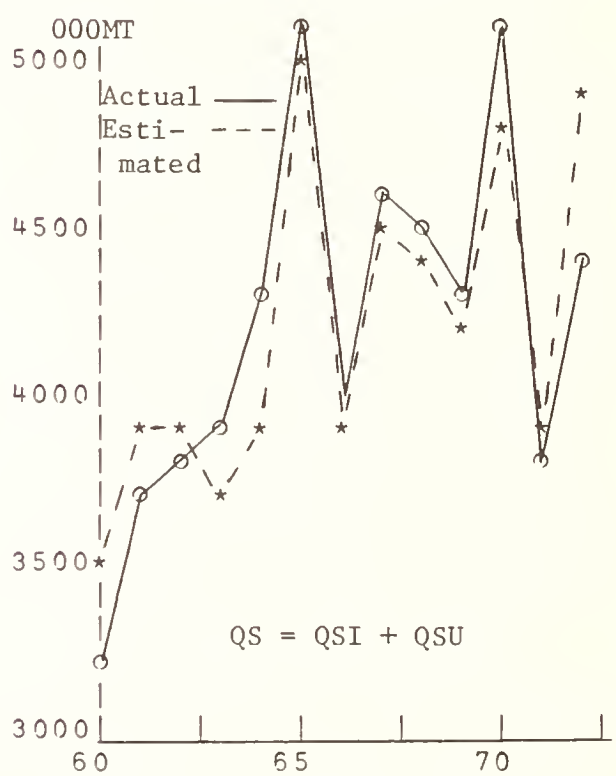
Disappearance



Irrigated Production

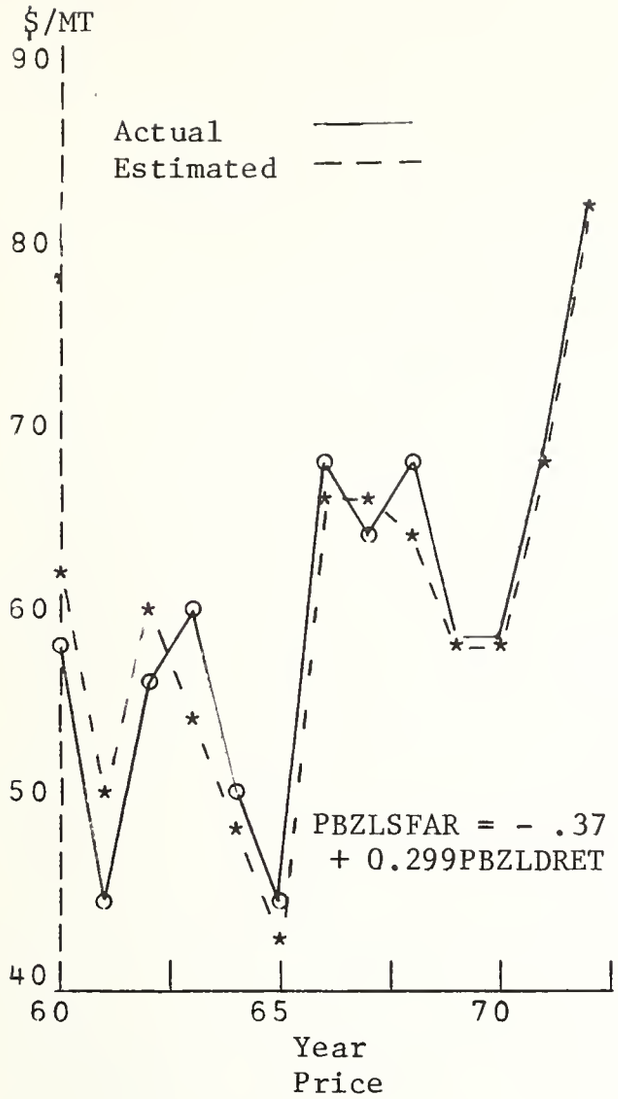


Upland Production



Total Production

BRAZIL


$/MT
90
80
70
60
50
40
Actual
Estimated
PBZLSFAR = - .37
+ 0.299PBZLDRET
60
65
70
Year
Price

BRAZIL

BURMA

I. Disappearance

1. $QDD = [- .0894 - \underset{(1.38)}{.0022PBURDFAR} + \underset{(2.04)}{.00236T} + \underset{(2.06)}{.000022QS}]POP^{-}$

$R^2 = .74$ S = .01 Data = 1962-72

II. Production

1. $QS = - 3121.4009 + \underset{(.37)}{7.3457PBURSFAR} + \underset{(6.82)}{6.9997YIELD} + \underset{(1.25)}{1.1083HA\ IR}$

$- \underset{(2.36)}{1.7749HYV}$

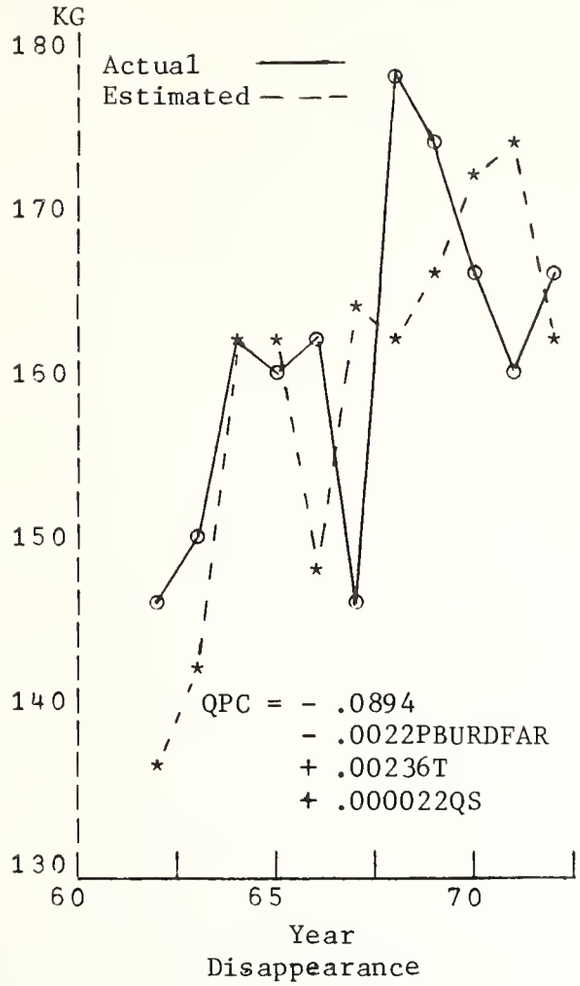
$R^2 = .91$ S = 122.5 Data = 1962-72

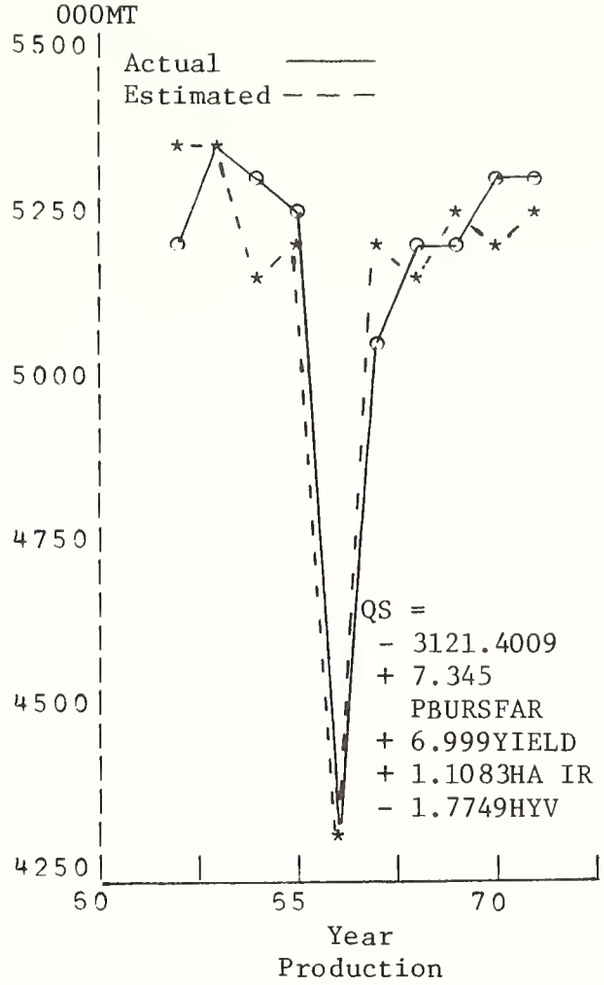
III. Price Relationships

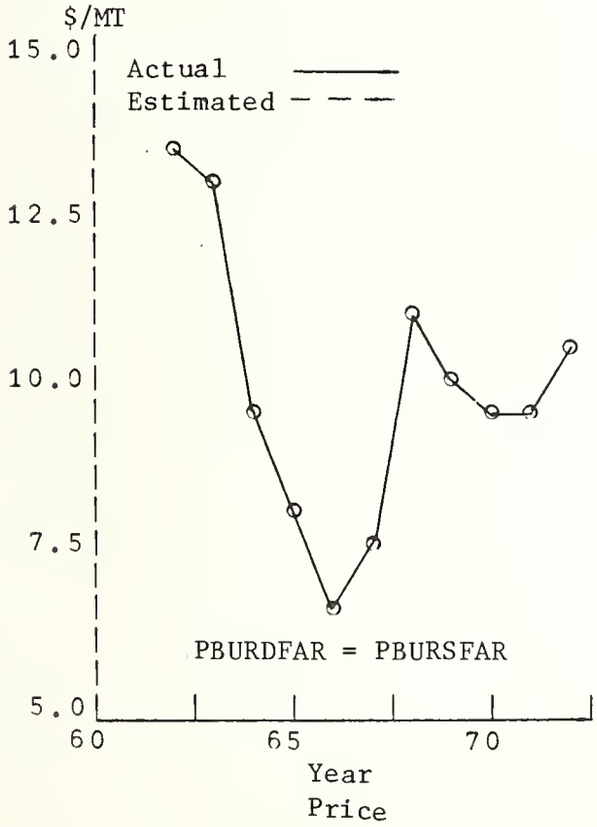
1. PBURDFAR = PBURSFAR

2. PBURDFAR = FIXED

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PBURDFAR = Low quality farm price, U.S. dollars per metric ton
- PBURSFAR = Low quality farm price, U.S. dollars per metric ton
- T = Years, 1970 = 70
- POP = Population in thousands
- YIELD = Yield in kilograms per hectare
- HA IR = Thousand hectares irrigated rice
- HYV = Thousand hectares high yielding varieties.


KG
180
170
160
150
140
130
Actual
Estimated
QPC = - .0894
- .0022PBURDFAR
+ .00236T
+ .000022QS
60
65
70
Year
Disappearance


000MT
5500
5250
5000
4750
4500
4250
Actual
Estimated
QS =
- 3121.4009
+ 7.345
PBURSFAR
+ 6.999YIELD
+ 1.1083HA IR
- 1.7749HYV
60
65
70
Year
Production


$/MT
15.0
12.5
10.0
7.5
5.0
Actual
Estimated
PBURDFAR = PBURSFAR
60
65
70
Year
Price

BURMA

CANADA

I. Disappearance

1. $QDD = [1.6115 - \underset{(2.54)}{.0016}PCANDIMP + \underset{(7.74)}{.264}YPC]POP$

$R^2 = .86$ S = .10 Data = 1960-73

II. Production

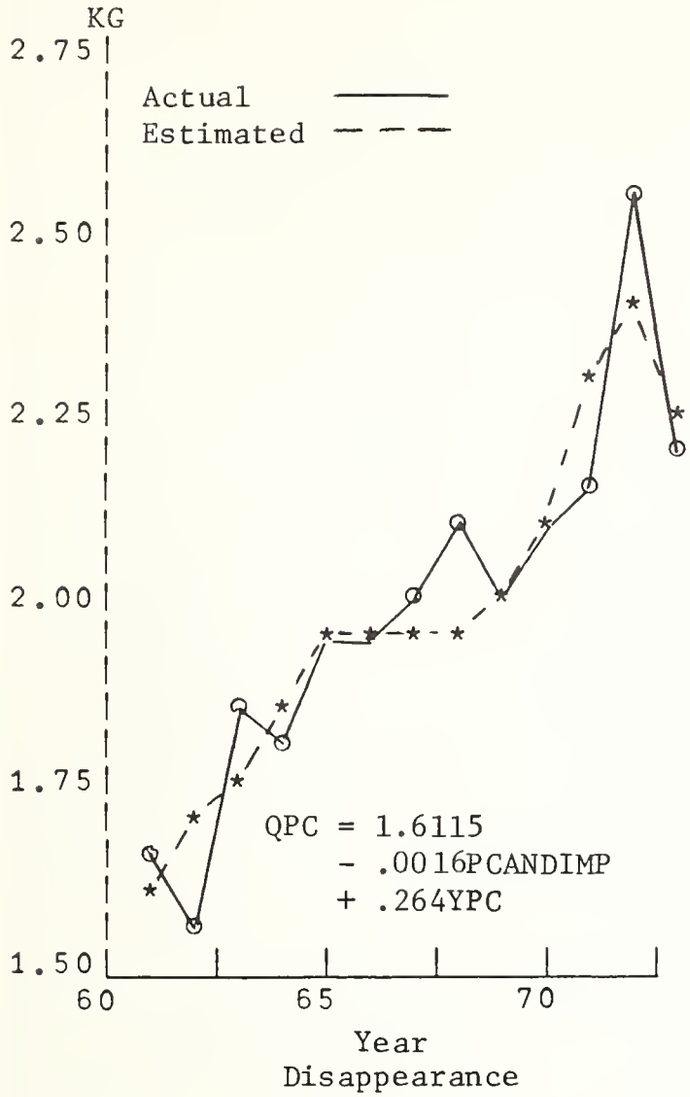
(none)

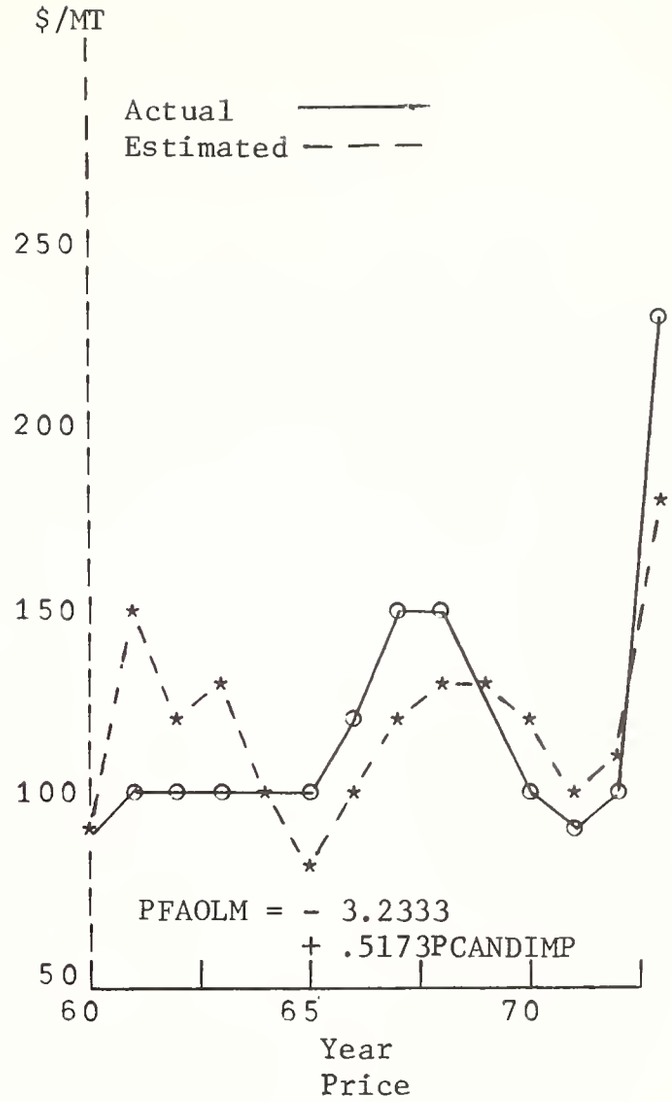
III. Price Relationships

1. $PFAOLM = - 3.2333 + \underset{(3.38)}{.5173}PCANDIMP$

$R^2 = .49$ S = 27.85 Data = 1960-73

Where: QDD = Domestic disappearance in thousand metric tons milled rice
PCANDIMP = Import rice price in U.S. dollars per metric ton
YPC = Per capita income in thousand U.S. dollars
POP = Population in millions
PFAOLM = FAO long-medium grain rice price index, 1957-59 = 100


KG
2.75
2.50
2.25
2.00
1.75
1.50
Actual
Estimated
QPC = 1.6115
- .0016PCANDIMP
+ .264YPC
60
65
70
Year
Disappearance


$/MT
250
200
150
100
50
Actual
Estimated
PFAOLM = - 3.2333
+ .5173PCANDIMP
60
65
70
Year
Price

CHINA AND OTHERS

I. Disappearance

1. $QDD = [67.6229 - \underset{(.17)}{.0036PCASDEXP} + \underset{(.53)}{.1574PWA} - \underset{(2.97)}{3.0346LOWPROD}$

$+ \underset{(1.33)}{.0001QS}]POP$

$R^2 = .61$ S = 1.65 Data = 1960-72

II. Production

1. $QS = - 52054.3306 + \underset{(.88)}{21.600PFAOLM} + \underset{(2.08)}{1.3151HA\ RI} + \underset{(5.37)}{1091.2935T}$

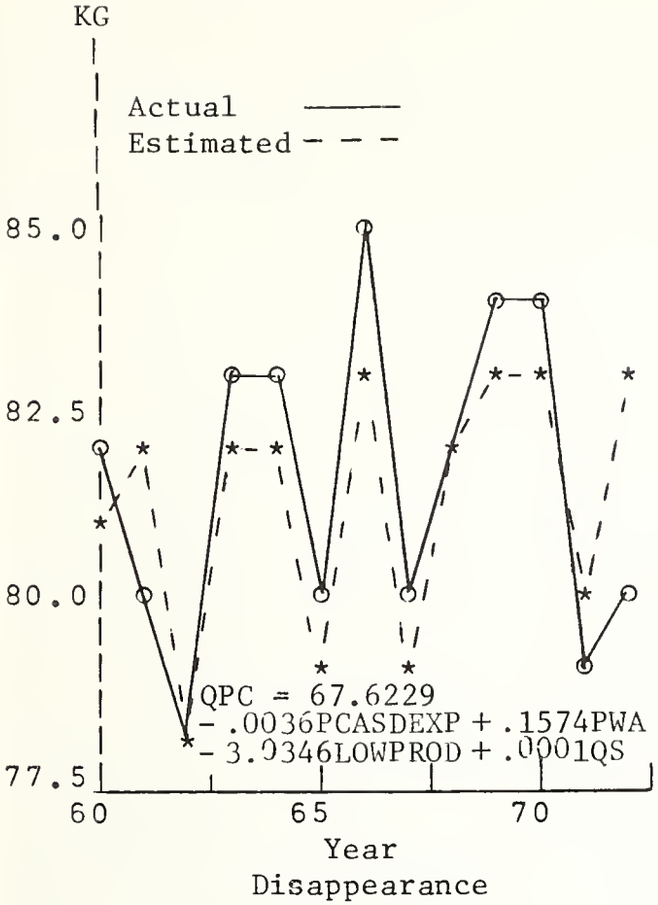
$R^2 = .95$ S = 1153.10 Data = 1960-72

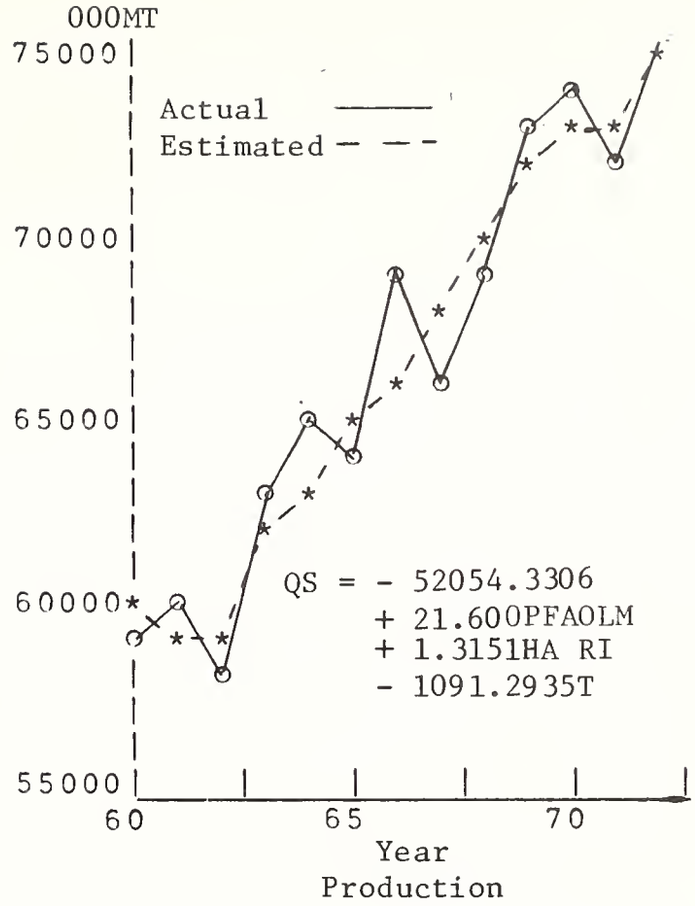
III. Price Relationships

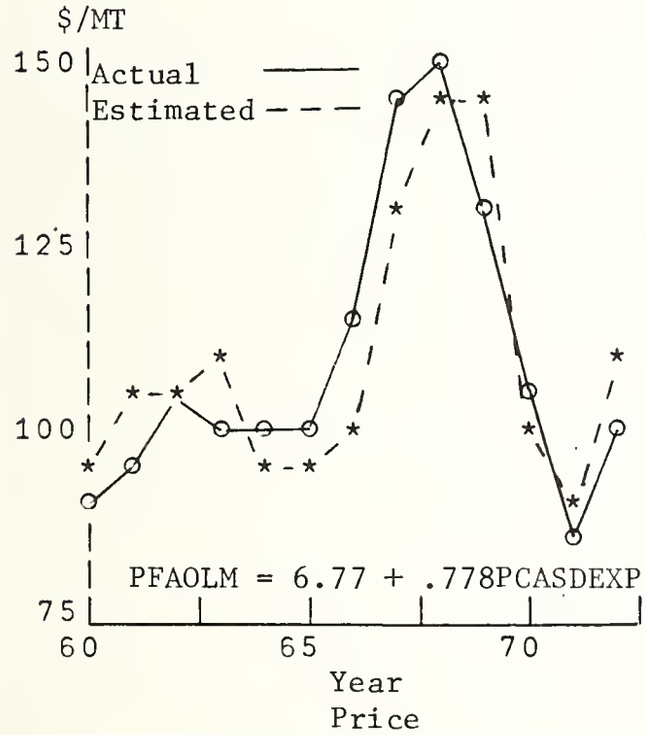
1. $PFAOLM = 6.77 + \underset{(6.81)}{.778PCASDEXP}$

$R^2 = .81$ S = 9.43 Data = 1960-72

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PCASDEXP = Export rice price, low quality, U.S. dollars per metric ton
- PFAOLM = FAO long-medium grain rice price index, 1957-59 = 100
- LOWPROD = Dummy, 0 = good, 1 = bad
- PWA = Australia wheat price in U.S. dollars per metric ton
- POP = Midyear population in millions
- T = Years, 1960 = 60
- HA RI = Area in rice in thousand hectares







CHINA AND OTHERS (CHINA, NORTH KOREA,
NORTH VIETNAM, AND MACAO)

CUBA[a/]

I. Disappearance

1. $QDD = 138.077 - .1464PCUBDFAO + 10.974POP + .9444QS$
   (.34) (.42) (4.86)

   $R^2 = .75$ S = 49.61 Data = 1960-73

II. Production

1. $QS = 131.1151 + 1.2309HA - 50.2952WEAT + 2.2275T$
   (10.32) (3.80) (1.38)

   $R^2 = .93$ S = 22.68 Data = 1960-73

III. Price Relationships

1. PCUBDFAO = PFAOLM

Where:

QDD	=	Domestic disappearance in thousand metric tons milled rice
QS	=	Domestic production in thousand metric tons milled rice
PFAOLM	=	FAO long-medium grain rice price index, 1957-59 = 100
PCUBDFAO	=	FAO long-medium grain rice price index, 1957-59 = 100
T	=	Years, 1960 = 60
POP	=	Midyear population in millions
HA	=	Thousand hectares in rice
WEAT	=	Dummy variable; 0 = good, 1 = bad

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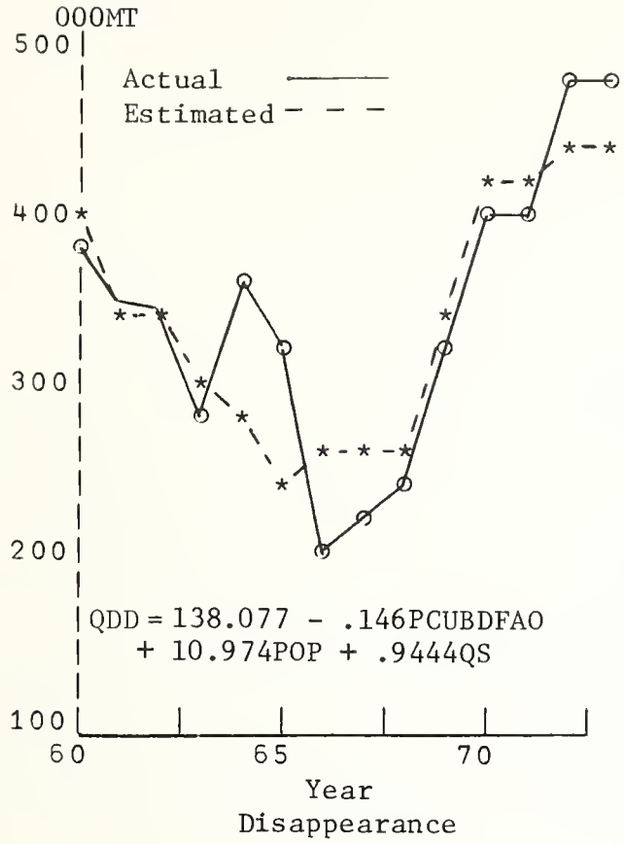
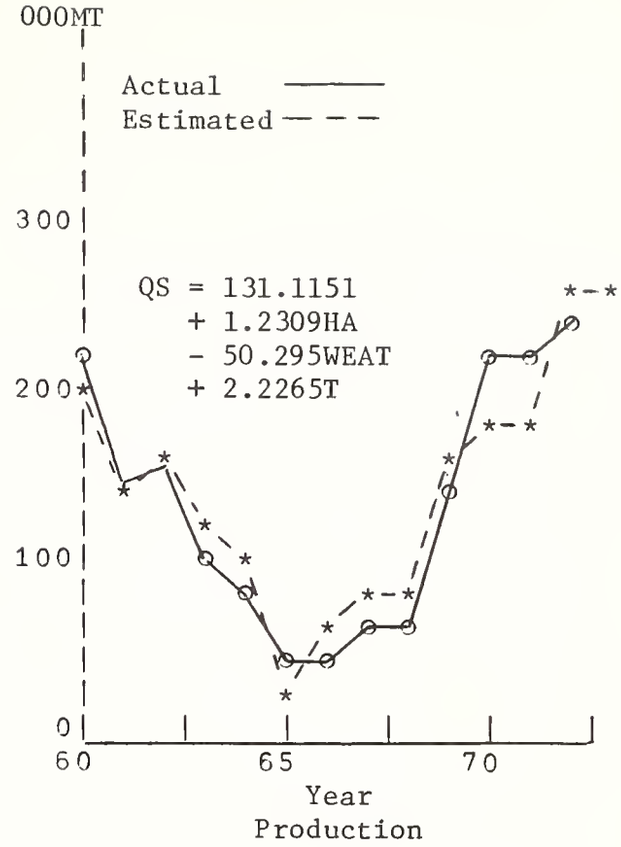
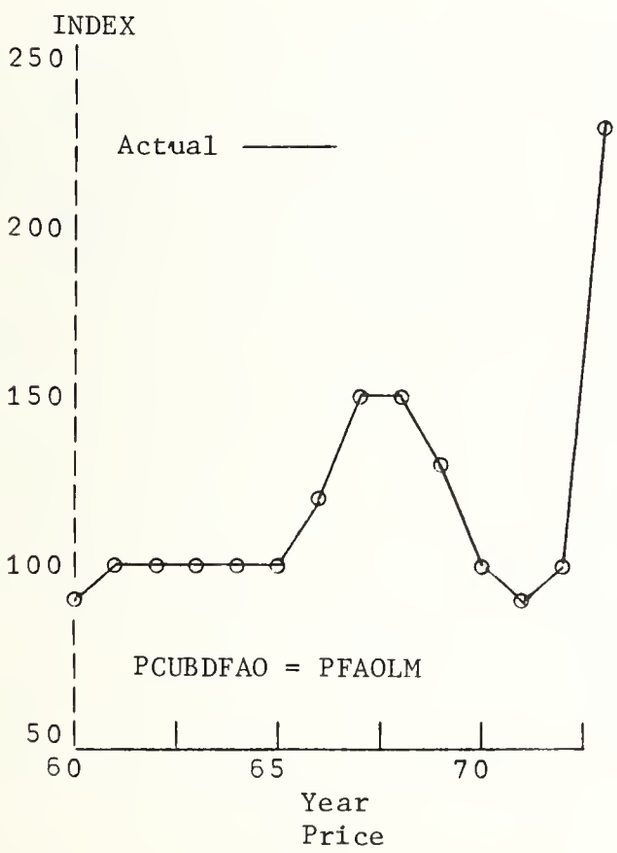
a/ In the production equation price was assumed perfectly inelastic. No internal price was found. External price had a negative sign.


000MT
500
400
300
200
100
Actual
Estimated
QDD = 138.077 - .146PCUBDFAO
+ 10.974POP + .9444QS
60
65
70
Year
Disappearance


000MT
300
200
100
0
Actual
Estimated
QS = 131.1151
+ 1.2309HA
- 50.295WEAT
+ 2.2265T
60
65
70
Year
Production


INDEX
250
200
150
100
50
Actual
PCUBDFAO = PFAOLM
60
65
70
Year
Price

CUBA

EGYPT

I. Disappearance

1. $QDD = [24.68 - \underset{(2.30)}{.256}PEGYDFAR + \underset{(3.53)}{.021}QS]POP$

$R^2 = .61$ S = .005 Data = 1960-70

II. Production

1. $QS = - 1412.8757 + \underset{(3.19)}{24.4466}PEGYSFAR + \underset{(1.31)}{.3004}YIELD$

$R^2 = .61$ S = 216.25 Data = 1960-70

III. Price Relationships

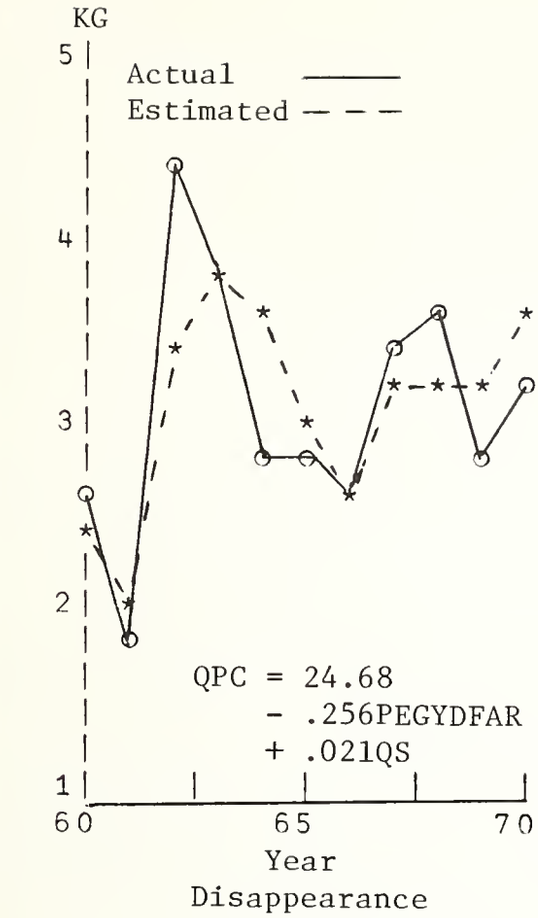
1. $PEGYDFAR = 20.1820 + \underset{(8.80)}{.7872}PEGYSFAR$

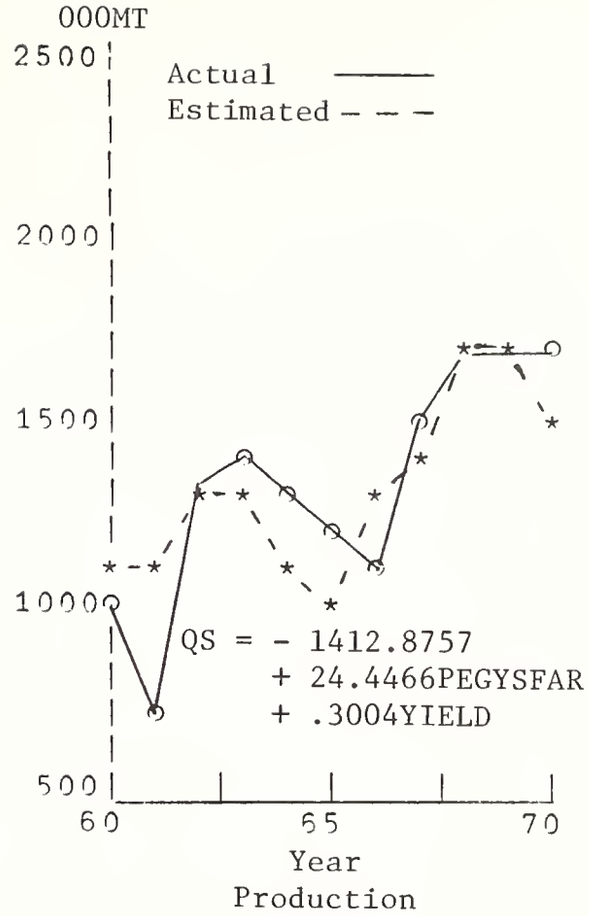
$R^2 = .90$ S = 5.61 Data = 1960-70

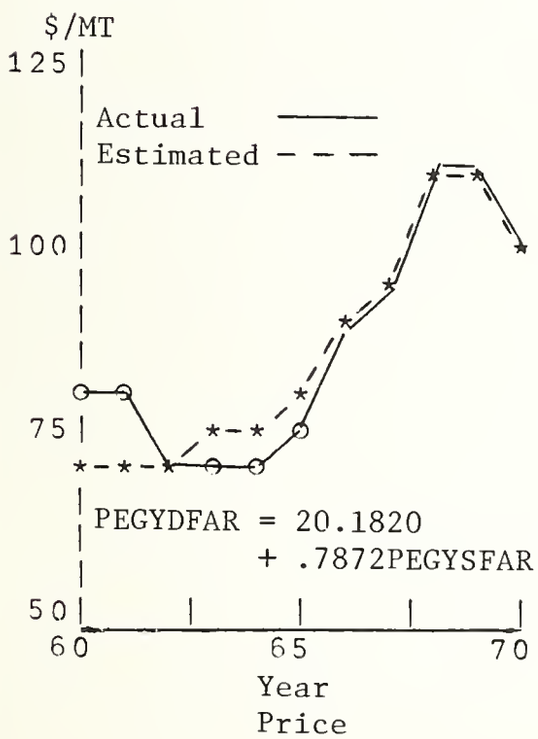
2. $PEGYDFAR = 62.62 + \underset{(N.A.)}{.208}PFAOEXR$

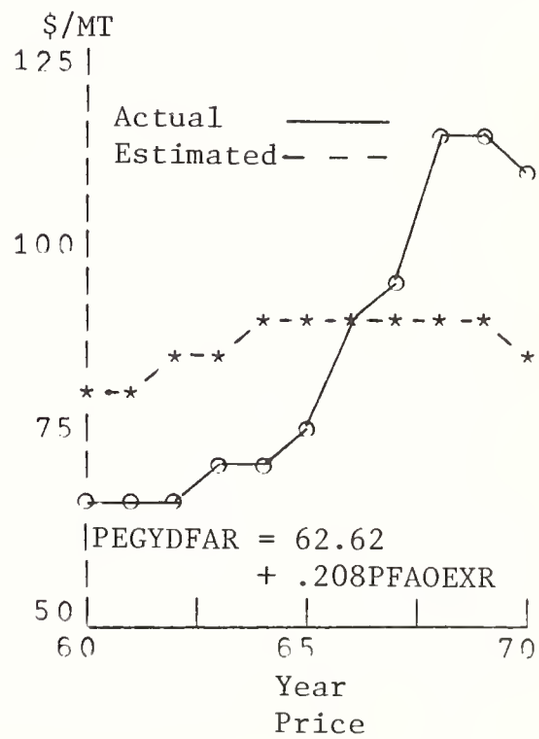
R^2 = N.A. S = N.A. Data = 1960-70

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PEGYSFAR = Farm price low quality, U.S. dollars per metric ton
- PEGYDFAR = Farm price low quality, U.S. dollars per metric ton
- PFAOEXR = FAO round grain price index, 1957-59 = 100
- POP = Population in millions
- YIELD = Yield per hectare in kilograms


KG
5
4
3
2
1
Actual
Estimated
QPC = 24.68
- .256PEGYDFAR
+ .021QS
60
65
70
Year
Disappearance


000MT
2500
2000
1500
1000
500
Actual
Estimated
QS = - 1412.8757
+ 24.4466PEGYSFAR
+ .3004YIELD
60
65
70
Year
Production


$/MT
125
100
75
50
Actual
Estimated
PEGYDFAR = 20.1820
+ .7872PEGYSFAR
60
65
70
Year
Price


$/MT
125
100
75
50
Actual
Estimated
PEGYDFAR = 62.62
+ .208PFAOEXR
60
65
70
Year
Price

EGYPT

EUROPEAN COMMUNITY

I. Disappearance

1. $QDD = -500.6348 - .2907PEECDIMP + 15.2331T$
(1.01) (2.88)

$R^2 = .53$ S = 27.16 Data = 1967-72

II. Production

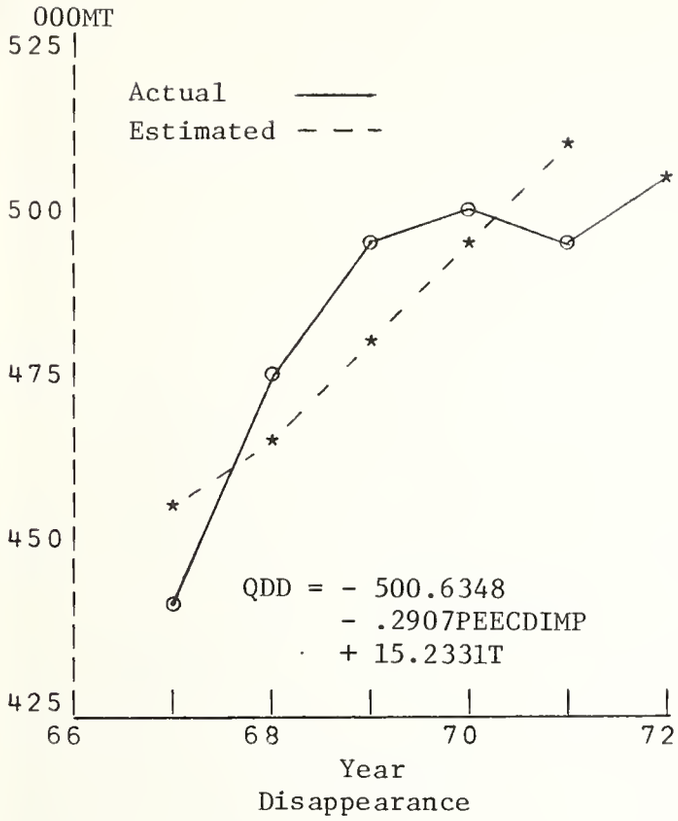
1. QS = FIXED

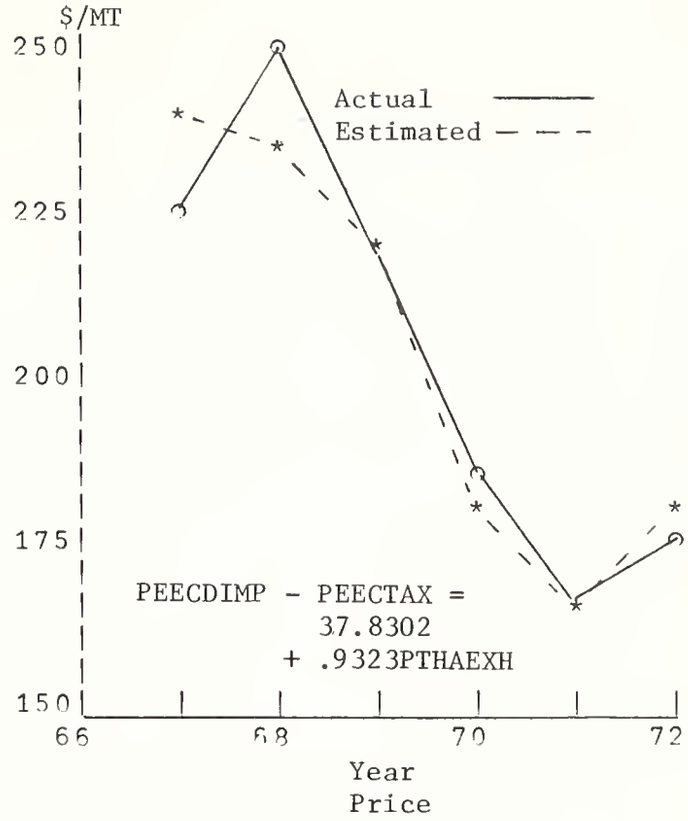
III. Price Relationships

1. $PEECDIMP-PEECTAX = 37.8302 + .9323PTHAEXH$
(6.73)

$R^2 = .92$ S = 10.36 Data = 1967-72

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PEECDIMP = Long-medium grain import price, U.S. dollars per metric ton
- PEECTAX = Variable levy, U.S. dollars per metric ton
- PTHAEXH = Thailand export price, high quality, U.S. dollars per metric ton
- T = Years, 1967 = 67





EUROPEAN COMMUNITY

EUROPEAN NET IMPORTERS

I. Disappearance

1. $QDD = -49.0220 - \underset{(.77)}{.1446}PENIDIMP + \underset{(3.97)}{4.5015}T$

$R^2 = .67$ S = 10.98 Data = 1960-70

II. Production

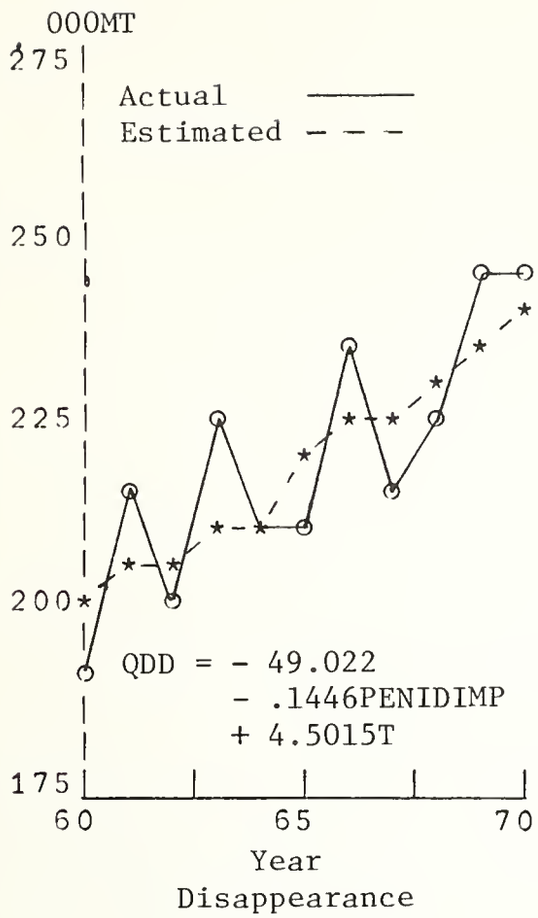
QS = FIXED

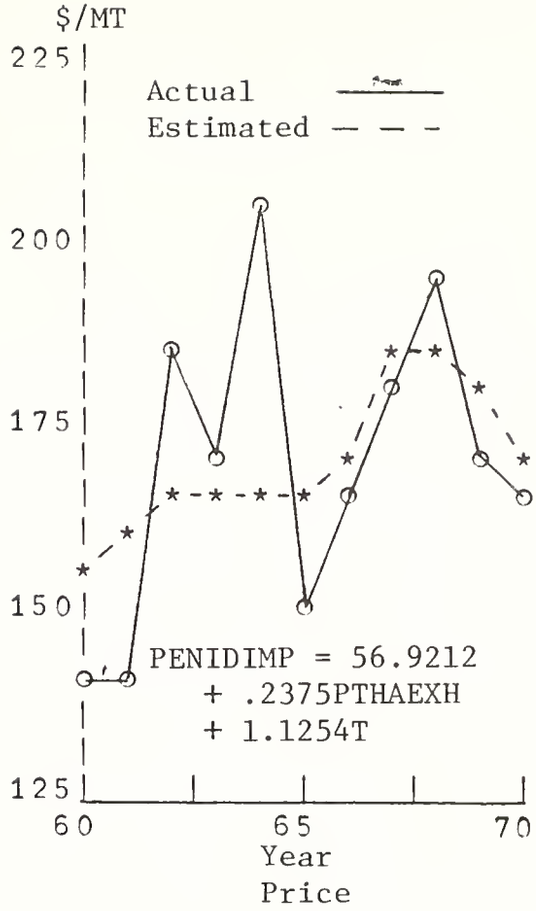
III Price Relationships

1. $PENIDIMP = 56.9212 + \underset{(.84)}{.2375}PTHAEXH + \underset{(.46)}{1.1254}T$

$R^2 = .22$ S = 19.98 Data = 1960-70

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PENIDIMP = Long-medium grain import price, U.S. dollars per metric ton
- PTHAEXH = Thailand, export price high quality, U.S. dollars per metric ton
- T = years, 1960 = 60





EUROPEAN NET IMPORTERS

I. Disappearance

1. $QDD = [.1432 - \underset{(1.53)}{.0001468}PHKGDEXP - \underset{(3.56)}{.000038}YPC]POP$

$R^2 = .63$ S = .01 Data = 1960-72

II. Production

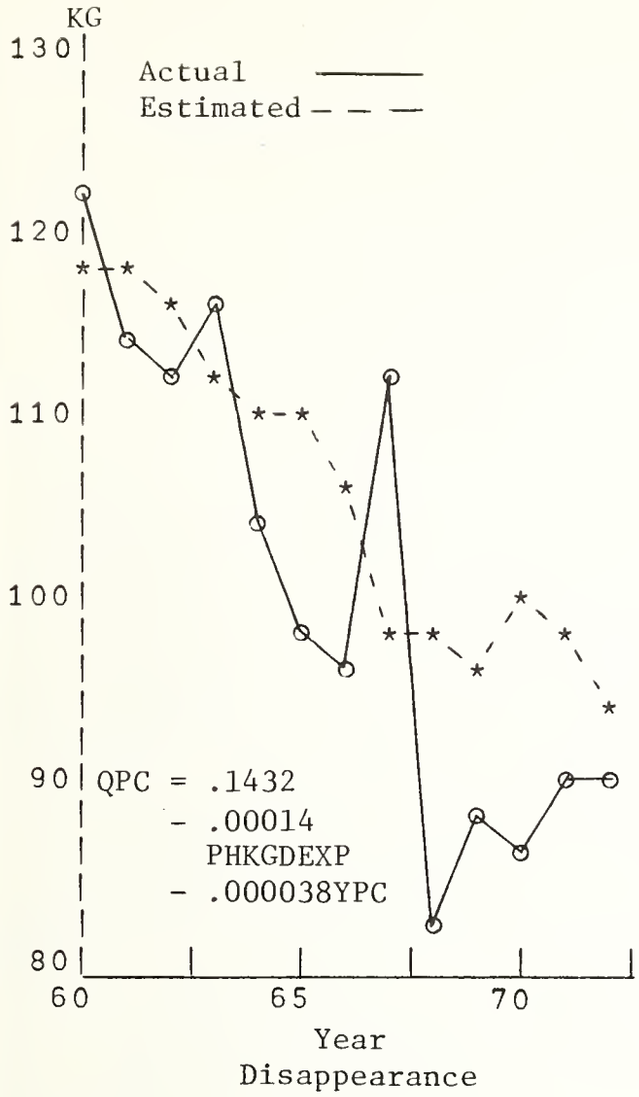
1. QS = FIXED

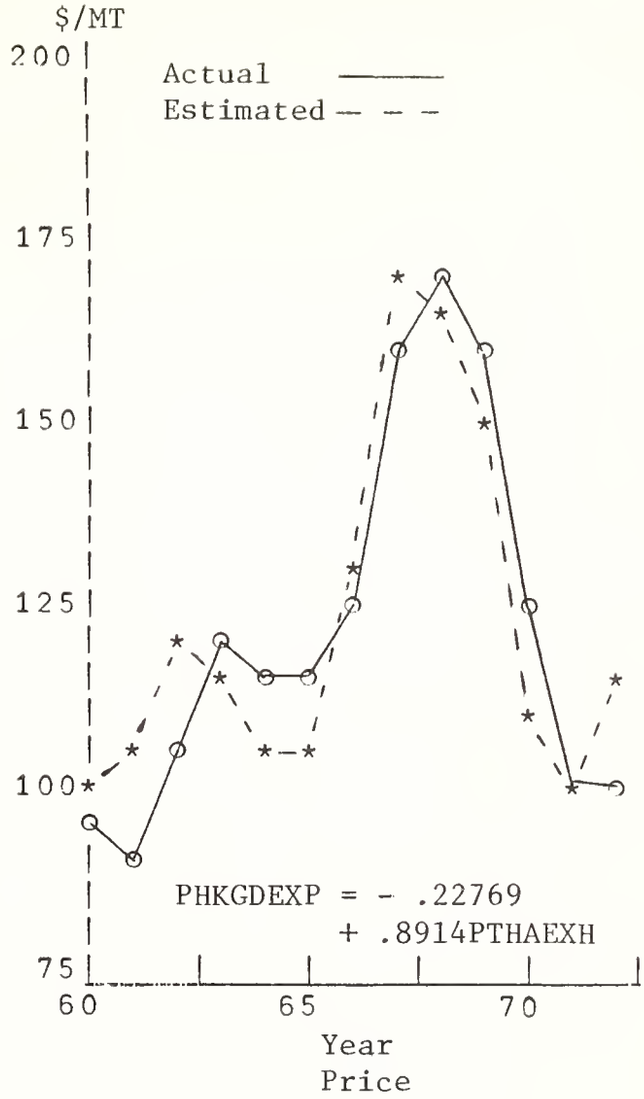
III. Price Relationships

1. $PHKGDEXP = - .22769 + \underset{(7.55)}{.8914}PTHAEXH$

$R^2 = .84$ S = 11.12 Data = 1960-72

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PHKGDEXP = Export price, low quality, U.S. dollars per metric ton
- PTHAEXH = High quality export price, Thailand, U.S. dollars per metric ton
- YPC = Income per capita U.S. dollars
- POP = Midyear population in millions


KG
130
120
110
100
90
80
Actual
Estimated
QPC = .1432
- .00014
PHKGDEXP
- .000038YPC
60
65
70
Year
Disappearance


$/MT
200
175
150
125
100
75
Actual
Estimated
PHKGDEXP = - .22769
+ .8914PTHAEXH
60
65
70
Year
Price

HONG KONG

INDIA

I. Disappearance

1. QDD = 6118.2311 - 2292.6728PINDDRET/PWR + 35.5978POP + .454QS
(1.06) (2.70) (3.29)
R^2 = .84 S = 1558.22 Data = 1960-73

II. Production

1. QS = QSI + QSR

2. QSI = 13786.9770 + 36.9265PINDSFAR - 26.9233PWF + 3.0196FERT
(2.16) (1.70) (11.53)
- 1072.8126S WEATHER
(3.80)
R^2 = .99 S = 407.18 Data = 1960-73

3. QSR = 20185.3806 + 14.4497PINDSFAR - 5.8614PWF + .2823FERT
- 2336.5848MS WEATHER - 5445.9595S WEATHER

QSR equation derived from the following equations:

(a) YLDR = 929.9739 + .0125FERT - 103.4702MS WEATHER - 241.1616
(1.22) (4.50) (10.50)
S WEATHER
R^2 = .92 S = 33.93 Data = 1960-73

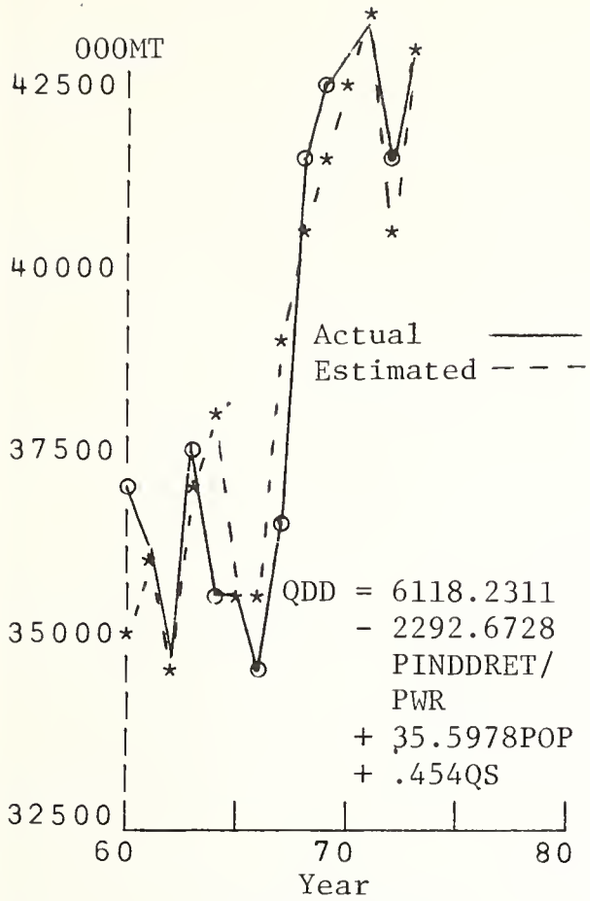
(b) QSR = - 815.476 + 14.4497PINDSFAR - 5.8614PWF + 22.5822YLDR
(1.41) (.49) (26.57)
R^2 = .99 S = 314.81 Data = 1960-73

III. Price Relationships

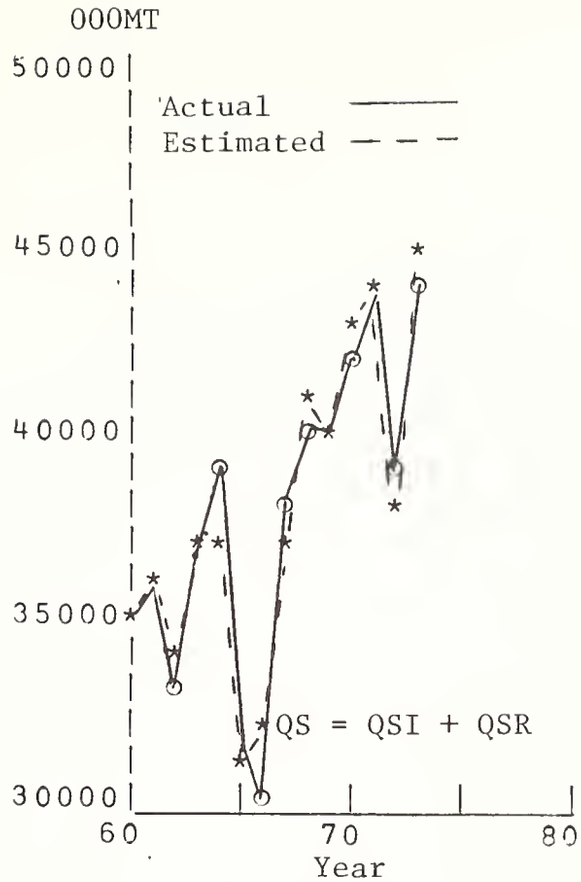
1. PINDDRET = 17.8018 + 1.4517PINDSFAR
(4.82)
R^2 = .66 S = 17.38 Data = 1960-73

2. PFAOLM = - 45.6386 + 1.6520PINDDRET
(4.62)
R^2 = .68 S = 12.60 Data = 1960-71

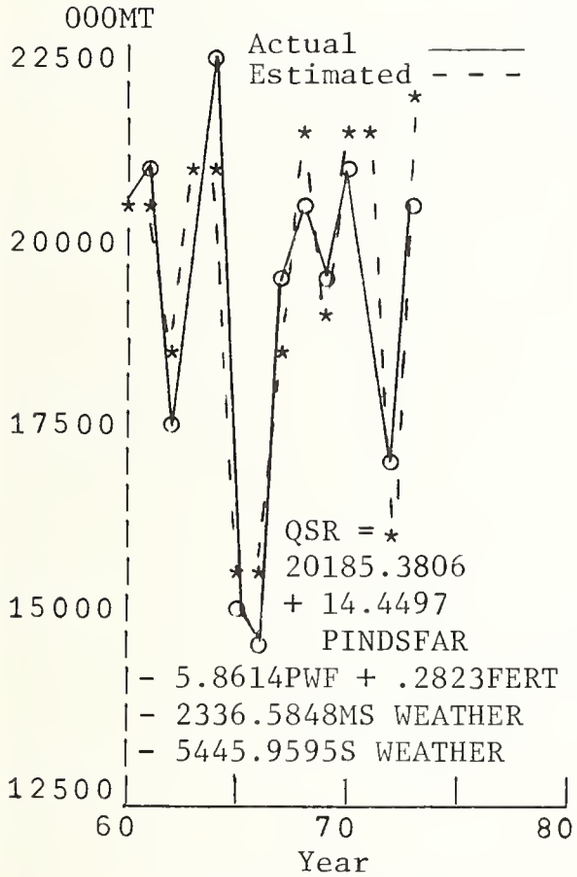
Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- QSI = Irrigated production in thousand metric tons milled rice
- QSR = Rainfed production in thousand metric tons milled rice
- PINDDRET = Retail price rice, long grain, U.S. dollars per metric ton
- PINDSFAR = Farm price rice, low quality, U.S. dollars per metric ton
- PFAOLM = FAO long grain rice price index, 1957-59 = 100
- PWR = Retail price wheat in U.S. dollars per metric ton
- POP = Midyear population in millions
- PWF = Farm price wheat in U.S. dollars per metric ton
- FERT = Fertilizer nutrients in thousand metric tons
- MS WEATHER = Moderately severe weather; 0 = good, 1 = bad
- S WEATHER = Severe weather; 0 = good, 1 = bad
- YLDR = Rainfed yield per hectare in kilograms



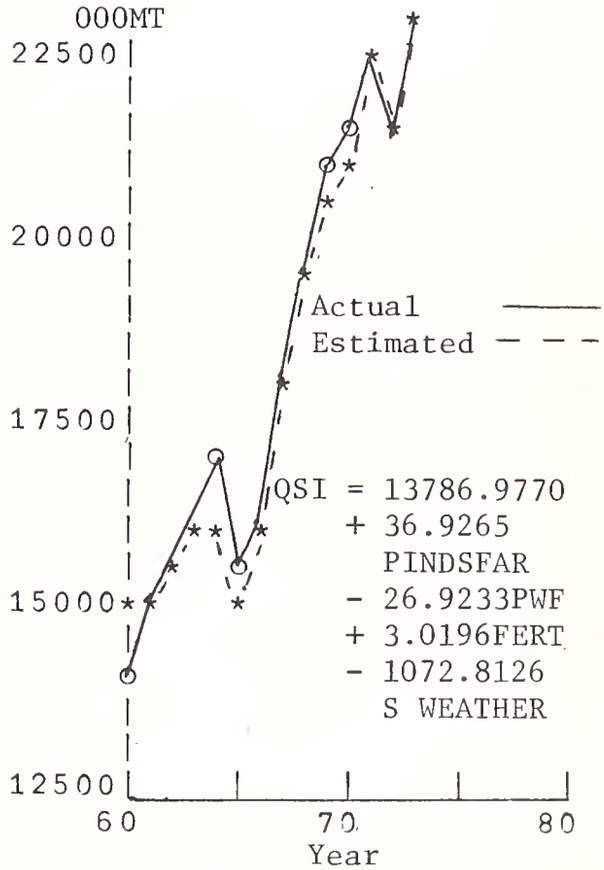
Disappearance



Total Production

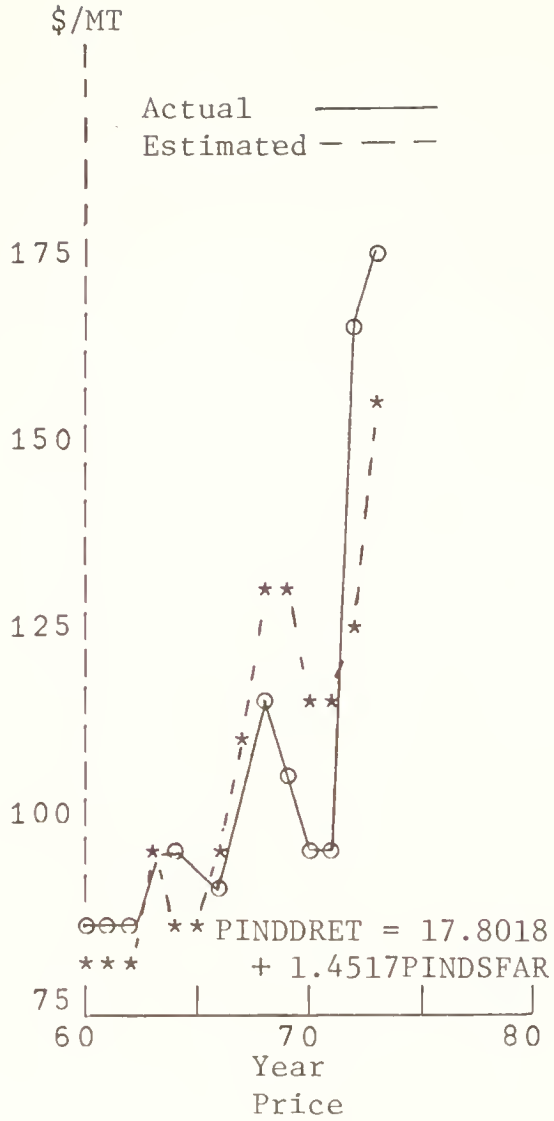


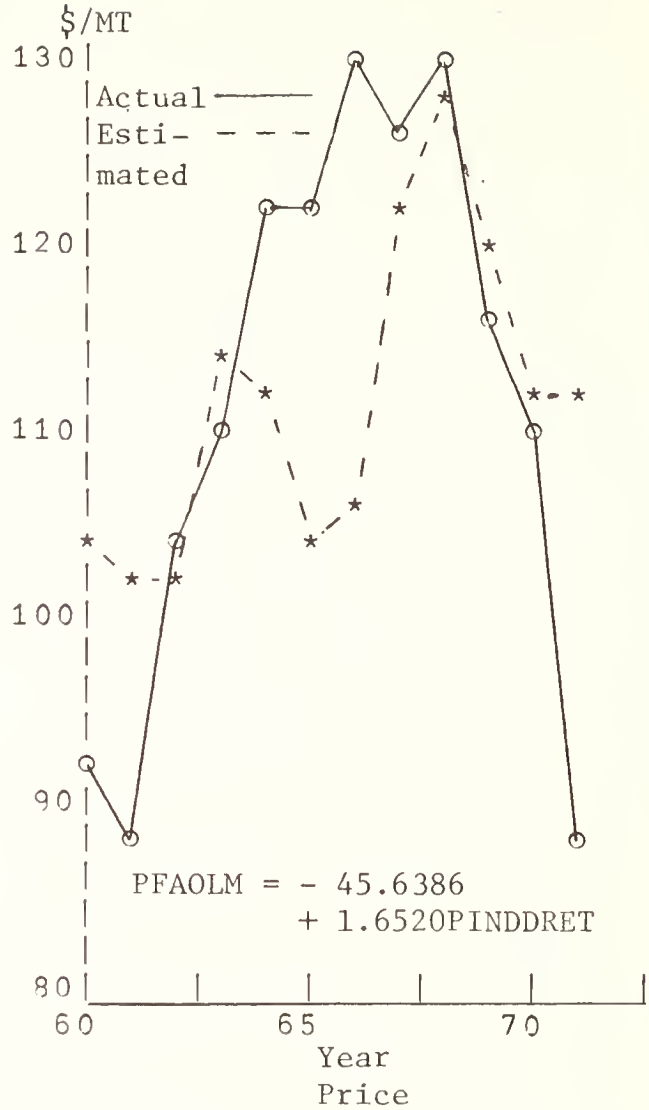
Rainfed Production



Irrigated Production

INDIA


$/MT
Actual
Estimated
175
150
125
100
75
PINDDRET = 17.8018
+ 1.4517PINDSFAR
60
70
80
Year
Price


$/MT
130
120
110
100
90
80
Actual
Esti-
mated
PFAOLM = - 45.6386
+ 1.6520PINDDRET
60
65
70
Year
Price

INDONESIA

I. Disappearance

1. $QDD = 10489.762 - \underset{(1.79)}{22.1468}PINADRET + \underset{(5.40)}{.6415}Y$

$R^2 = .90$ S = 521.97 Data = 1960-72

II. Production

1. $QS = - 7135.7126 + \underset{(.86)}{5.7880}PINASRET + \underset{(6.47)}{12.1679}YIELD$

$R^2 = .94$ S = 443.44 Data = 1960-72

III. Price Relationships

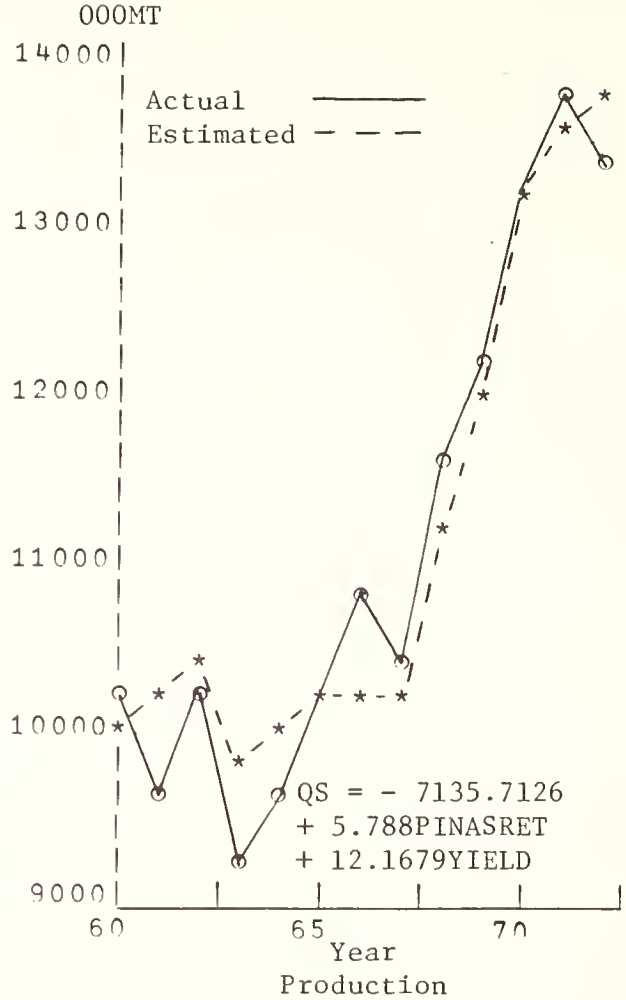
1. PINADRET = PINASRET

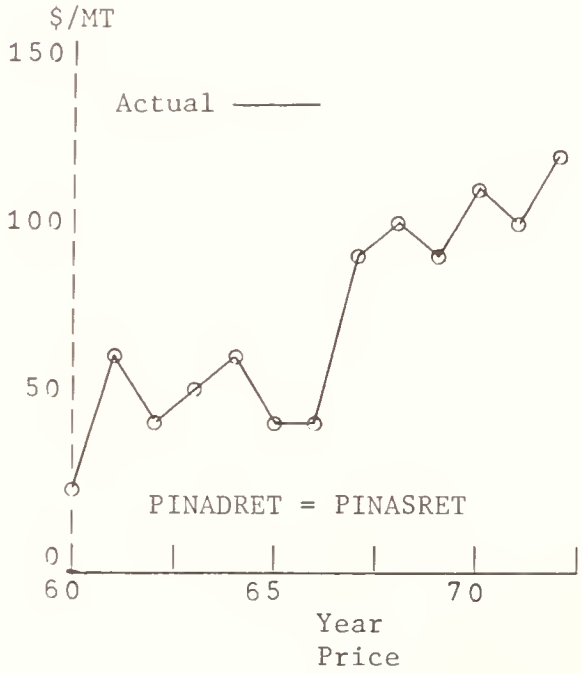
2. PINADRET = FIXED

Where:

QDD	= Domestic disappearance in thousand metric tons milled rice
QS	= Domestic production in thousand metric tons milled rice
PINADRET	= Low quality retail price U.S. dollars per metric ton
PINASRET	= Low quality retail price U.S. dollars per metric ton
Y	= Gross domestic product, million U.S. dollars
YIELD	= Yield per hectare in kilograms

000MT
15000
14000
13000
12000
11000
10000
Actual
Estimated
QDD = 10489.762
- 22.1468PINADRET
+ .6415Y
60
65
70
Year
Disappearance


000MT
14000
13000
12000
11000
10000
9000
Actual
Estimated
QS = - 7135.7126
+ 5.788PINASRET
+ 12.1679YIELD
60
65
70
Year
Production


$/MT
150
100
50
0
Actual
PINADRET = PINASRET
60
65
70
Year
Price

INDONESIA

ITALY

I. Disappearance

1. $QDD = [.005805 - \underset{(1.27)}{.0000033PITADFAR} - \underset{(6.11)}{.00000313YPC} + \underset{(3.20)}{.0000481PCF}]POP$

$R^2 = .94$ S = .00014 Data = 1960-72

II. Production

1. $QS = - 112.00 + \underset{(3.11)}{3.485PITASFAR} + \underset{(.62)}{.055HA\ RI} - \underset{(1.42)}{85.31WEATHER}$

$R^2 = .56$ S = 58.14 Data - 1960-72

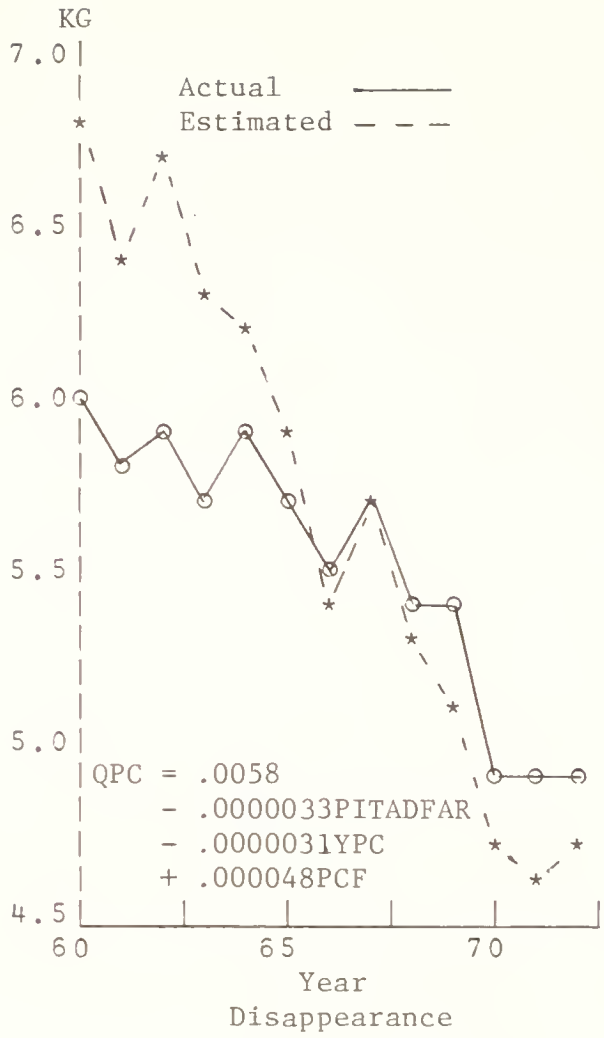
III. Price Relationships

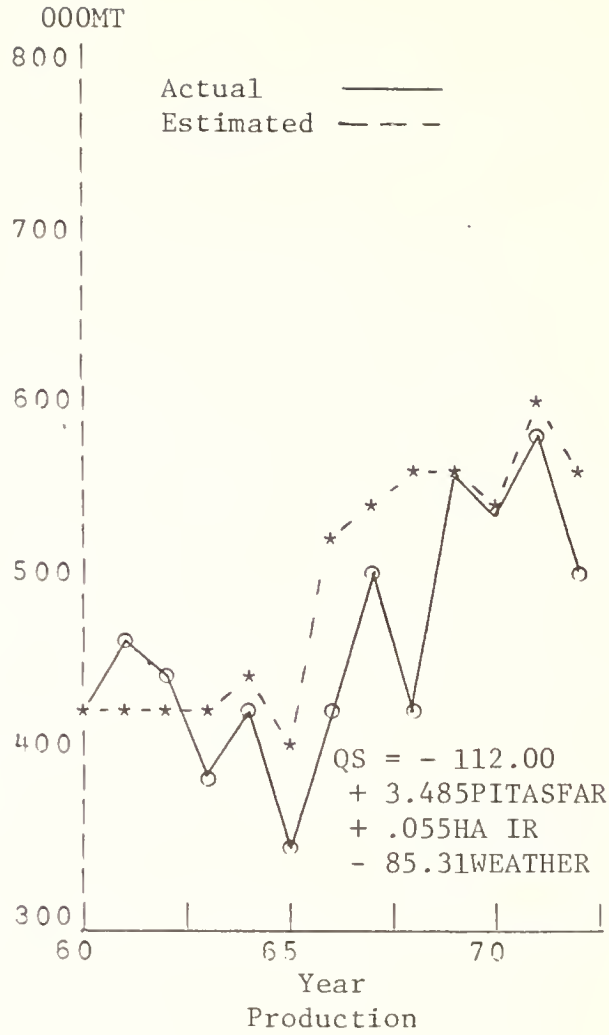
1. PITADFAR = PITASFAR

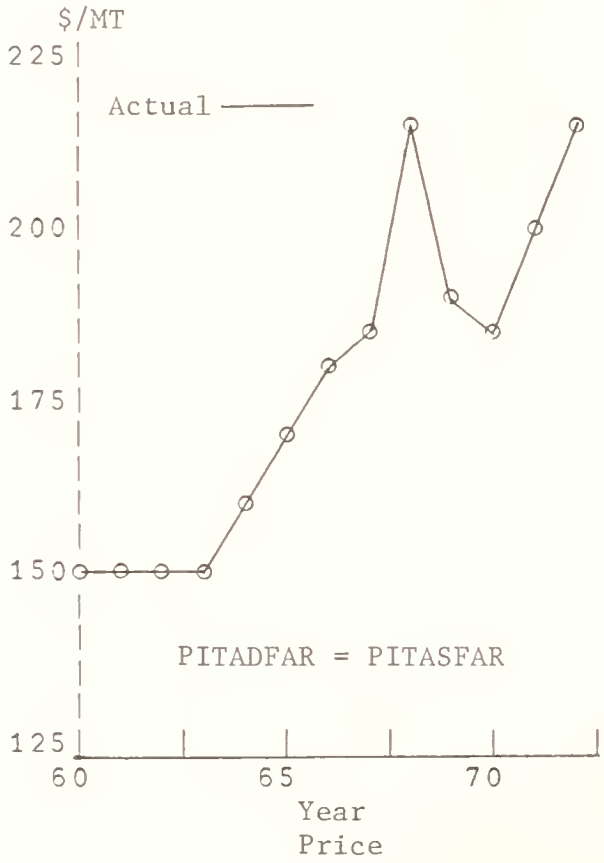
2. PITADFAR = FIXED

Where:

QDD	=	Domestic disappearance in thousand metric tons milled rice
QS	=	Domestic production in thousand metric tons milled rice
YPC	=	Income per capita in U.S. dollars
PCF	=	Farm price corn in U.S. dollars per metric ton
POP	=	Population in thousands
PITADFAR	=	High quality farm price, U.S. dollars per metric ton
PITASFAR	=	High quality farm price, U.S. dollars per metric ton
HA RI	=	Thousand hectares of rice
WEATHER	=	Dummy variable; 0 = good, 1 = bad


KG
7.0
6.5
6.0
5.5
5.0
4.5
Actual
Estimated
QPC = .0058
- .0000033PITADFAR
- .0000031YPC
+ .000048PCF
60
65
70
Year
Disappearance


000MT
800
700
600
500
400
300
Actual
Estimated
QS = - 112.00
+ 3.485PITASFAR
+ .055HA IR
- 85.31WEATHER
60
65
70
Year
Production


$/MT
225
200
175
150
125
Actual
PITADFAR = PITASFAR
60
65
70
Year
Price

ITALY

JAPAN

I. Disappearance

1. $QDD = [152.8592 - \underset{(6.88)}{.1254}PJAPDPRG/PWGS - \underset{(1.35)}{.0021}YPC]POP$

$R^2 = .96$ S = 2.27 Data = 1960-73

II. Production[a/]

1. QS = QDD

III. Price Relationships

1. PJAPDPRG = PJAPSPRG

2. PJAPDPRG = FIXED

Where:	QDD	= Domestic disappearance in thousand metric tons milled rice
	QS	= Domestic production in thousand metric tons milled rice
	PJAPDPRG/PWGS	= Ratio of Government selling price of rice and wheat, U.S. dollars per metric ton
	PJAPDPRG	= Government selling price of rice, U.S. dollars per metric ton
	PJAPSPRG	= Government selling price of rice, U.S. dollars per metric ton
	YPC	= Income per capita in U.S. dollars
	POP	= Midyear population in millions

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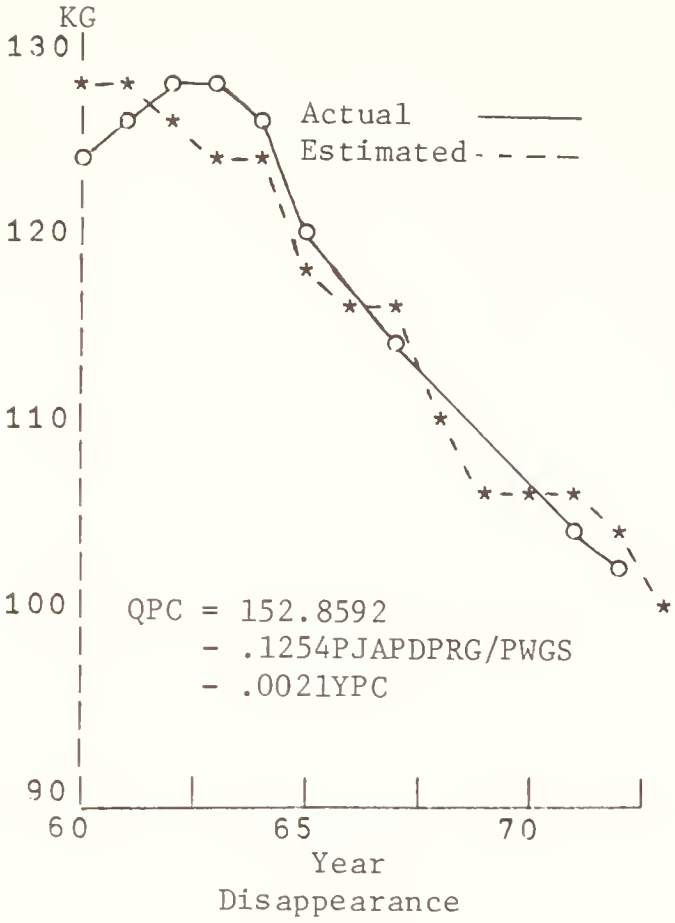
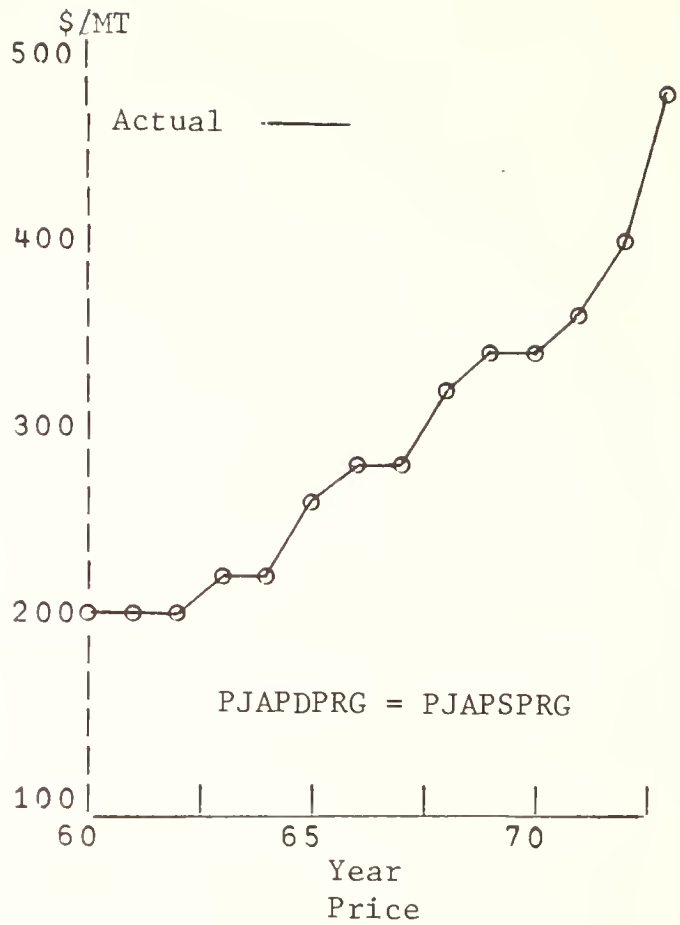
a/ The Japanese Government controls production with high price supports and diversion payments. The model, as stated, assumes that they will maintain self-sufficiency.


KG
130
120
110
100
90
Actual
Estimated
QPC = 152.8592
- .1254PJAPDPRG/PWGS
- .0021YPC
60
65
70
Year
Disappearance


$/MT
500
400
300
200
100
Actual
PJAPDPRG = PJAPSPRG
60
65
70
Year
Price

JAPAN

KHMER REPUBLIC

I. Disappearance

1. $QDD = [75.34 - \underset{(.004)}{.0027PCAMDWHO} - \underset{(1.80)}{26.425EXPORT} + \underset{(2.79)}{.0598QS}]POP$

$R^2 = .74$ S = .01 Data = 1961-70

II. Production

1. $QS = 225.97 + \underset{(.16)}{0.791PCAMSWHO} + \underset{(7.13)}{2.6180YIELD}$

$R^2 = .88$ S = 156.98 Data = 1961-70

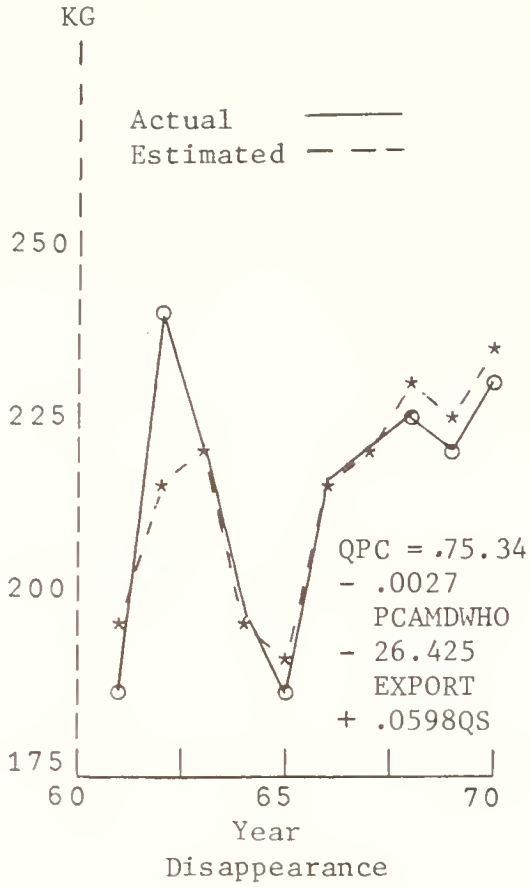
III. Price Relationships

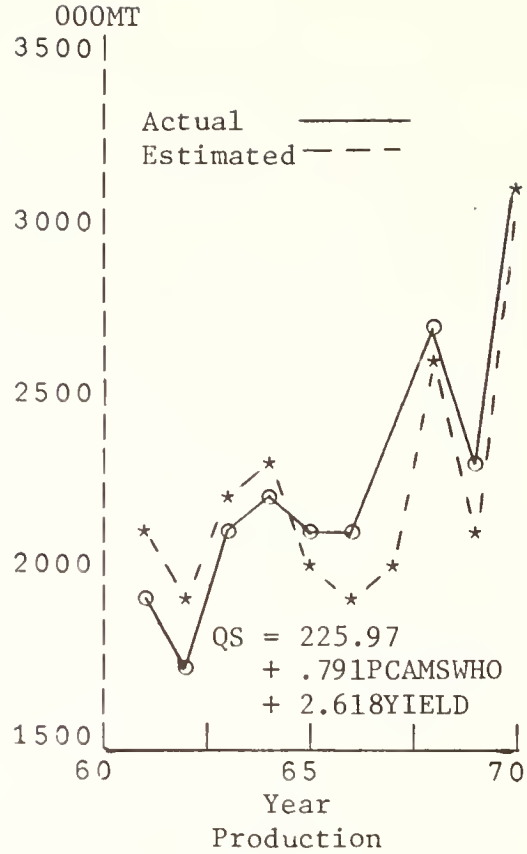
1. PCAMDWHO = PCAMSWHO

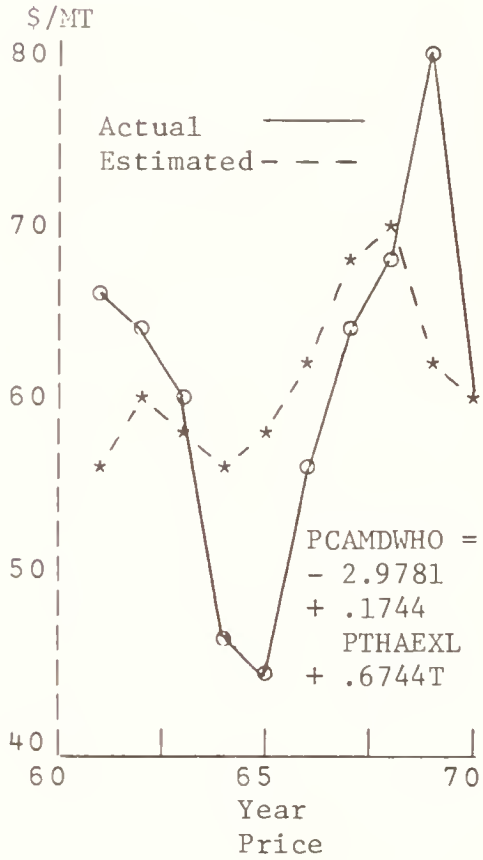
2. $PCAMDWHO = - 2.9781 + \underset{(1.04)}{.1744PTHAEXL} + \underset{(.56)}{.6744T}$

$R^2 = .19$ S = 10.69 Data = 1961-70

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PCAMSWHO = Low quality wholesale price, U.S. dollars per metric ton
- PCAMDWHO - Low quality wholesale price, U.S. dollars per metric ton
- EXPORT = Dummy, 0 = no policy, 1 = export policy in effect
- POP = Midyear population in thousands
- YIELD = Yield in kilograms per hectare
- PTHAEXL = Thailand export price, low quality, U.S. dollars per metric ton
- T = Years, 1961 = 61







KHMER REPUBLIC

KOREA, REPUBLIC OF

I. Disappearance

1. $QDD = [92.1157 - \underset{(.96)}{.2958}PSKODRET + \underset{(1.23)}{.3773}PBW + \underset{(.74)}{.5690}YPC - \underset{(1.48)}{.9641}YPC2]POP$

$R^2 = .43$ S = 11.10 Data = 1960-73

II. Production

1. $QS = -6888.36 + \underset{(2.26)}{3.349}PSKOSFAR + \underset{(2.99)}{8.033}RAIN - \underset{(2.70)}{.003}RAIN2 + \underset{(2.95)}{4.439}\ HA\ IR$

$R^2 = .92$ S = 131.49 Data = 1960-73

III. Price Relationships

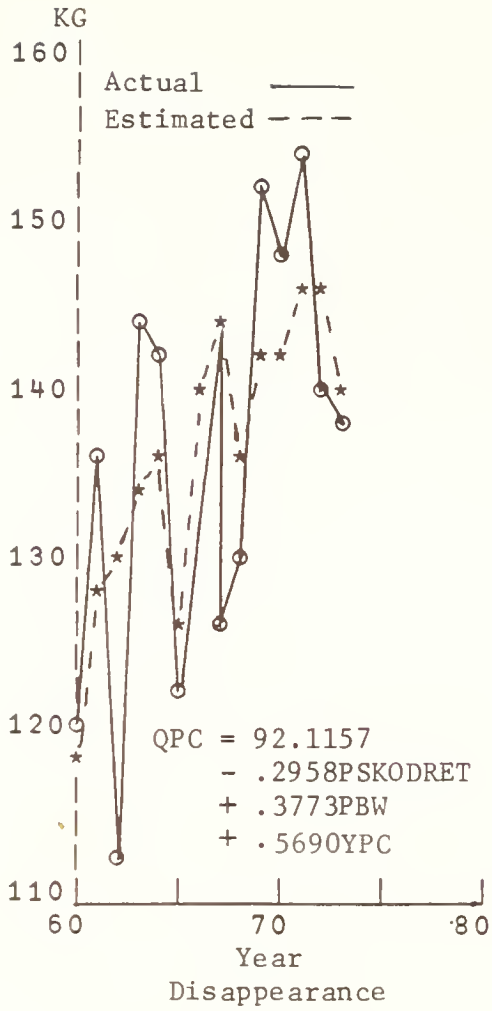
1. $PSKODRET = -10.42 + \underset{(15.05)}{1.261}PSKOSFAR$

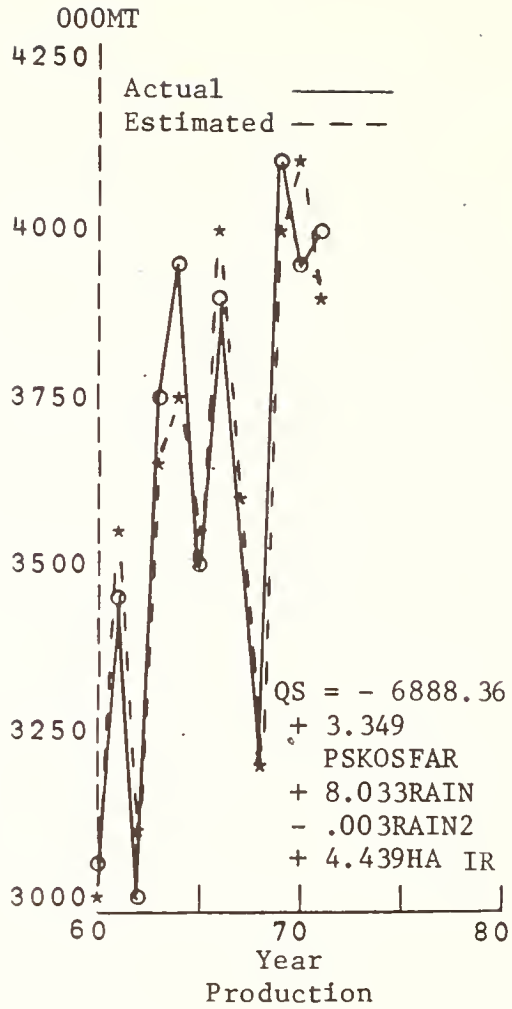
$R^2 = .95$ S = 17.27 Data = 1960-73

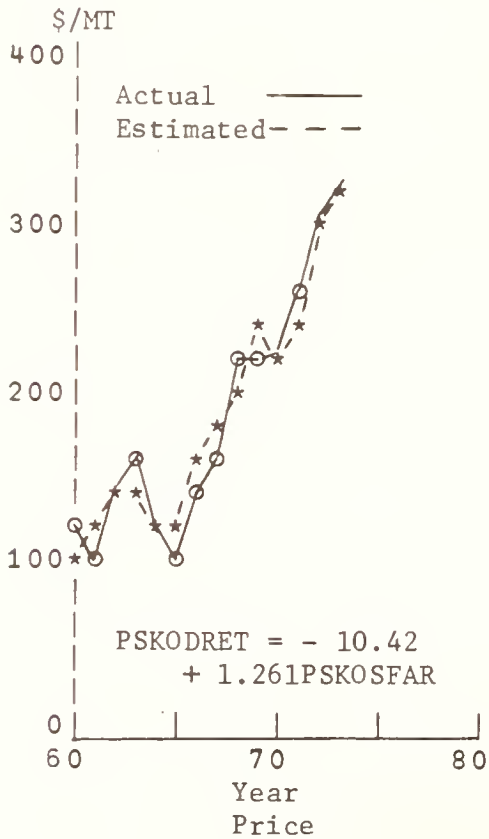
2. PSKOSFAR ≠ FIXED

Where:

QDD	=	Domestic disappearance in thousand metric tons milled rice
QS	=	Domestic production in thousand metric tons milled rice
PSKODRET	=	Low quality retail price rice, U.S. dollars per metric ton
PSKOSFAR	=	Low quality farm price rice, U.S. dollars per metric ton
PBW	=	Wholesale price of barley, U.S. dollars per metric ton
YPC	=	Per capita income in U.S. dollars
YPC2	=	Per capita income in U.S. dollars squared
POP	=	Population in millions
RAIN	=	Rainfall in millimeters
RAIN2	=	Rainfall in millimeters squared
HA IR	=	Thousand hectares in rice irrigated







KOREA, REPUBLIC OF

MALAGASY REPUBLIC

I. Disappearance

1. $QDD = -865.6643 - \underset{(.91)}{3.8429}PMRADFAR + \underset{(3.82)}{341.3173}POP$

$R^2 = .77$ S = 87.03 Data = 1960-70

II. Production

1. $QS = -1438.0048 + \underset{(1.17)}{1.008}PMRASWHO + \underset{(3.81)}{35.6354}T + \underset{(.98)}{.0331}YIELD$

$R^2 = .89$ S = 32158. Data = 1960-70

III. Price Relationships

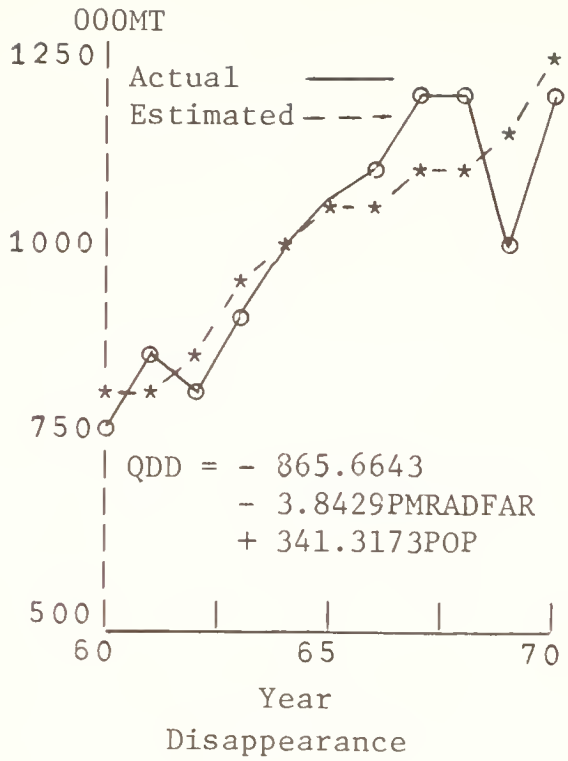
1. $PMRADFAR = 32.1566 + \underset{(3.92)}{.2104}PMRASWHO$

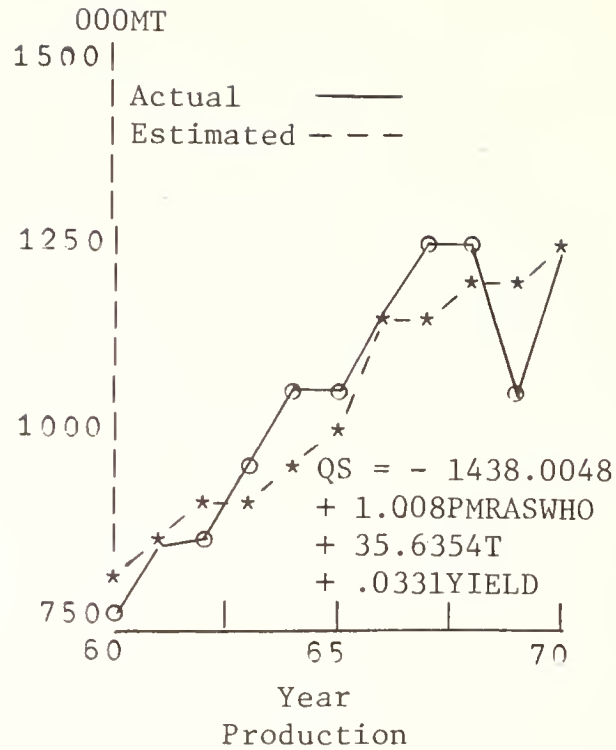
$R^2 = .63$ S = 6.88 Data = 1960-70

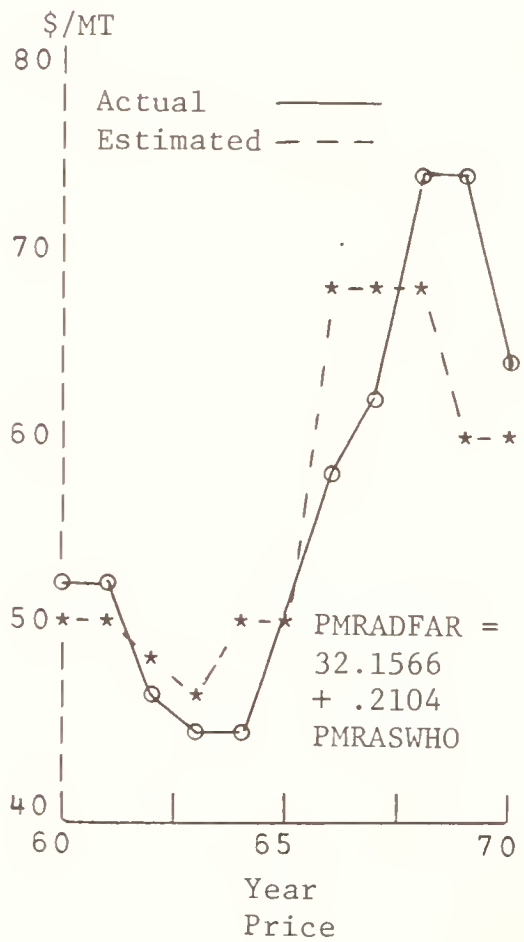
2. $PMRASWHO = -381.22 + \underset{(1.17)}{1.007}PFAOEXR + \underset{(1.58)}{5.860}T$

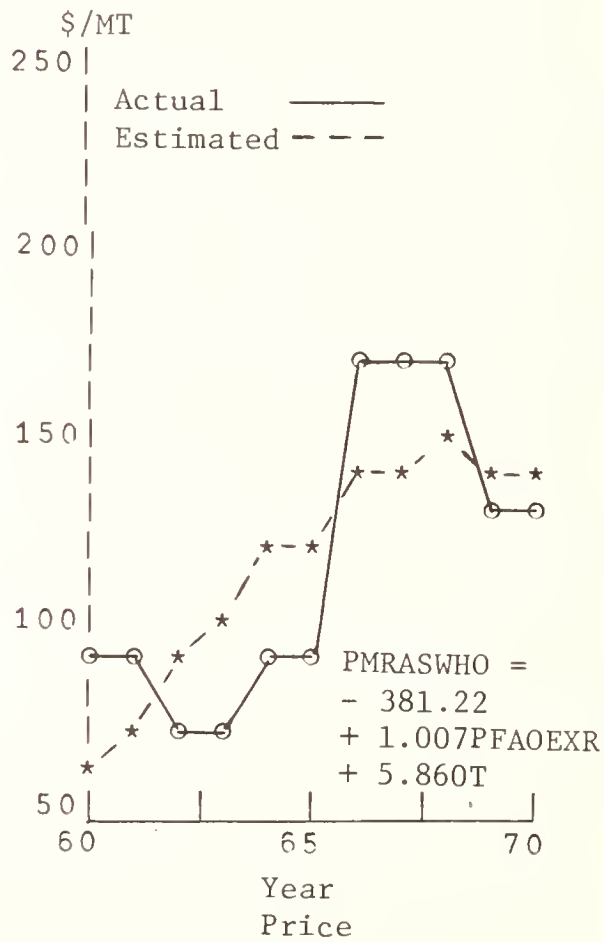
$R^2 = .59$ S = 29.05 Data = 1960-70

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PMRADFAR = Low quality farm price, U.S. dollars per metric ton milled rice
- PMRASWHO = Low quality wholesale price, U.S. dollars per metric ton milled rice
- PFAOEXR = FAO export price, round grain price index, 1957-59 = 100
- POP = Population in millions
- T = Years, 1960 = 60
- YIELD = Yield per hectare in kilograms









MALAGASY REPUBLIC

MALAYSIA

I. Disappearance

1. $QDD = 366.66 - 2.306PMALDIMP + 120.300POP$
(4.00) (8.79)

$R^2 = .92$ S = 45.10 Data = 1961-72

II. Production

1. $QS = -1632.6 + 3.722PMALSRET + 1.2277YIELD$
(3.09) (3.57)

$R^2 = .87$ S = 75.6 Data = 1961-72

III. Price Relationships

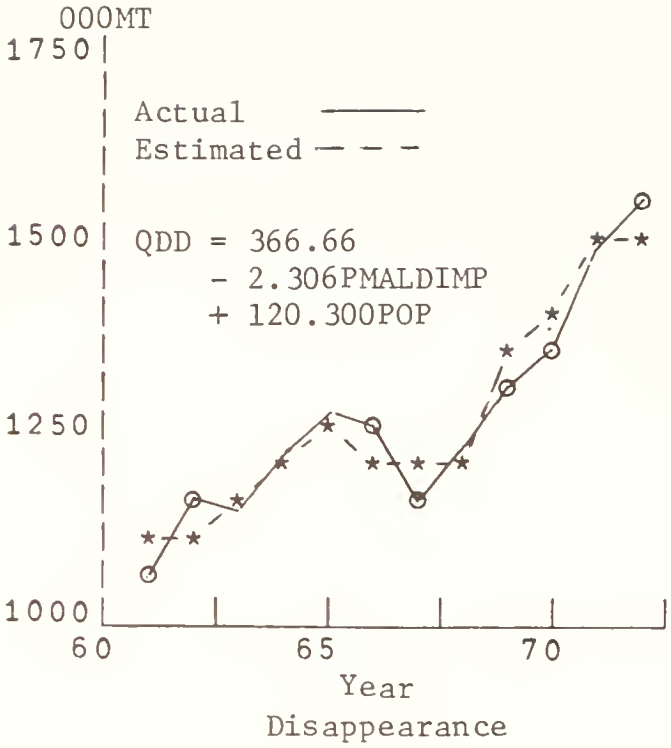
1. $PMALSRET = -220.01 + .3108PMALDIMP + 5.701T$
(2.71) (8.30)

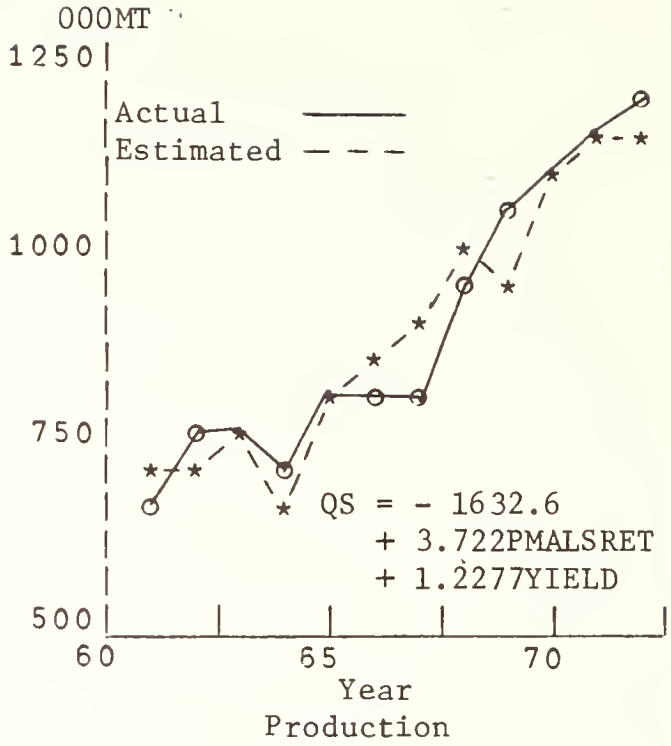
$R^2 = .88$ S = 9.25 Data = 1960-72

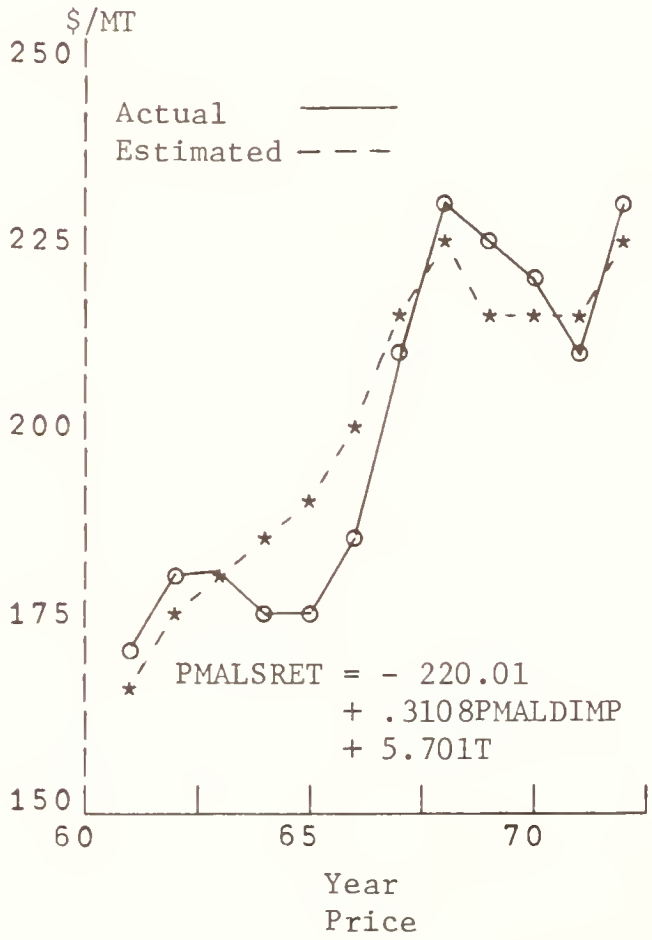
2. $PMALDIMP = 29.1025 + .999PTHAEXL$
(12.50)

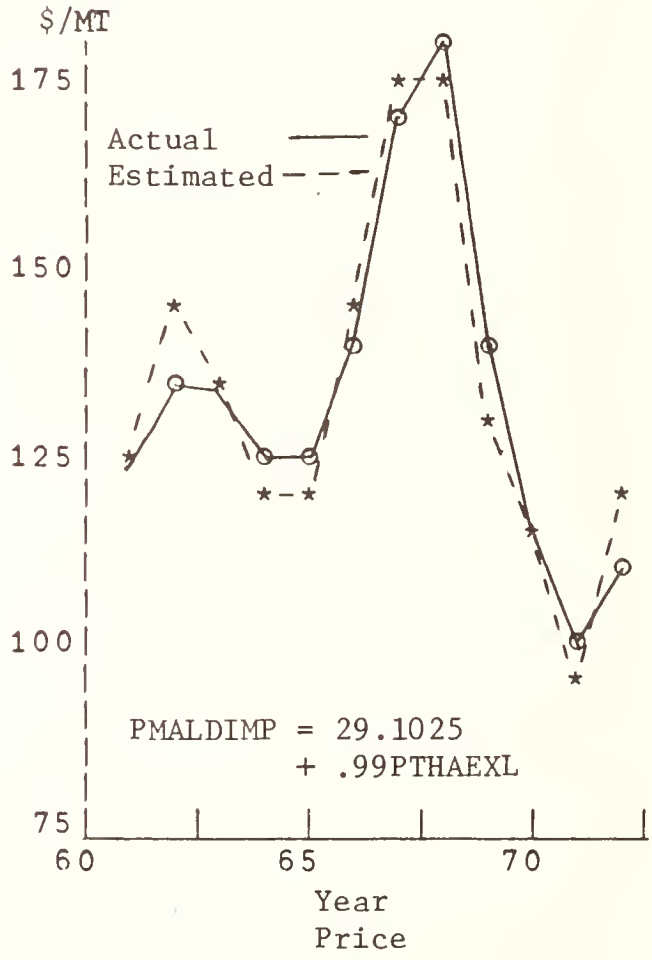
$R^2 = .94$ S = 6.14 Data = 1961-72

Where:
QDD = Domestic disappearance in thousand metric tons milled rice
QS = Domestic production in thousand metric tons milled rice
PMALDIMP = High quality import price, U.S. dollars per metric ton
PMALSRET = Low quality retail price, U.S. dollars per metric ton
YIELD = Kilograms per hectare
T = Years, 1960 = 60
POP = Midyear population in millions


000MT
1750
1500
1250
1000
Actual
Estimated
QDD = 366.66
- 2.306PMALDIMP
+ 120.300POP
60
65
70
Year
Disappearance


000MT
1250
1000
750
500
Actual
Estimated
QS = - 1632.6
+ 3.722PMALSRET
+ 1.2277YIELD
60
65
70
Year
Production


$/MT
250
225
200
175
150
Actual
Estimated
PMALSRET = - 220.01
+ .3108PMALDIMP
+ 5.701T
60
65
70
Year
Price


$/MT
175
150
125
100
75
Actual
Estimated
PMALDIMP = 29.1025
+ .99PTHAEXL
60
65
70
Year
Price

NEAR EAST SHORT GRAIN

I. Disappearance

1. $QDD = [5.6089 - \underset{(.06)}{.0009PARADFAR} - \underset{(1.91)}{.7363WEATHER} + \underset{(.22)}{.0008YPC}]POP$

$R^2 = .37$ S = .52 Data = 1960-70

II. Production

1. $QS = 2137.7736 + \underset{(.14)}{.1124PARASFAR} - \underset{(.96)}{70.6486T} - \underset{(2.66)}{3.7723PWI} + \underset{(1.08)}{66.421POP}$

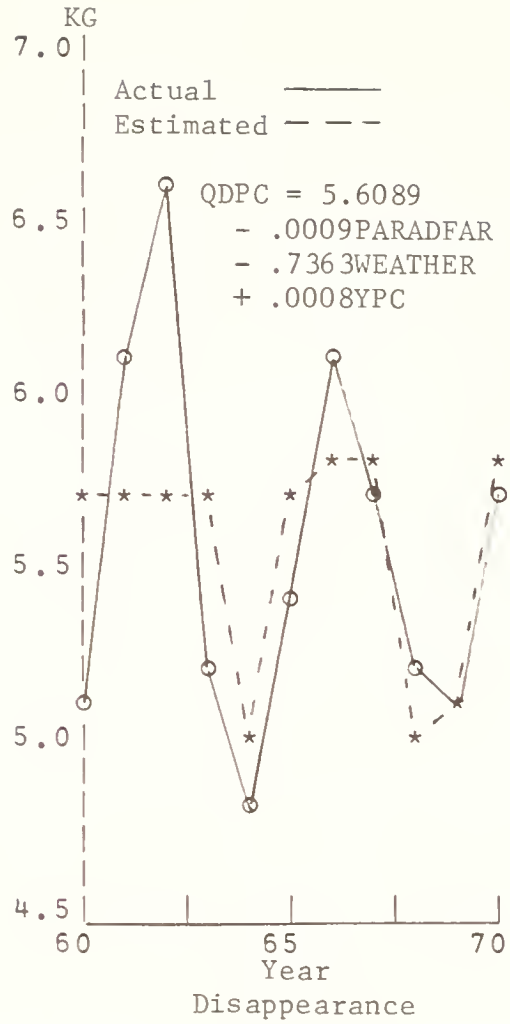
$R^2 = .58$ S = 18. Data = 1960-70

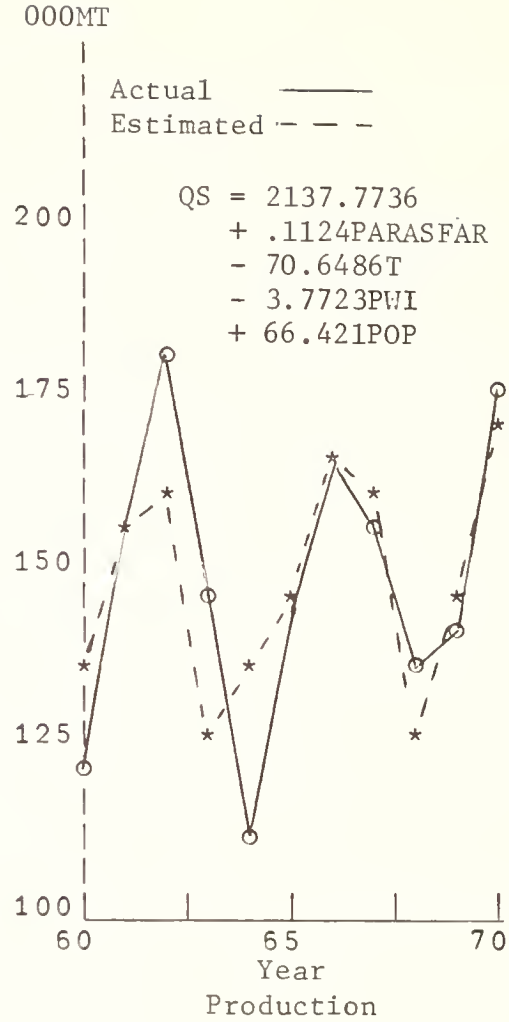
III. Price Relationships

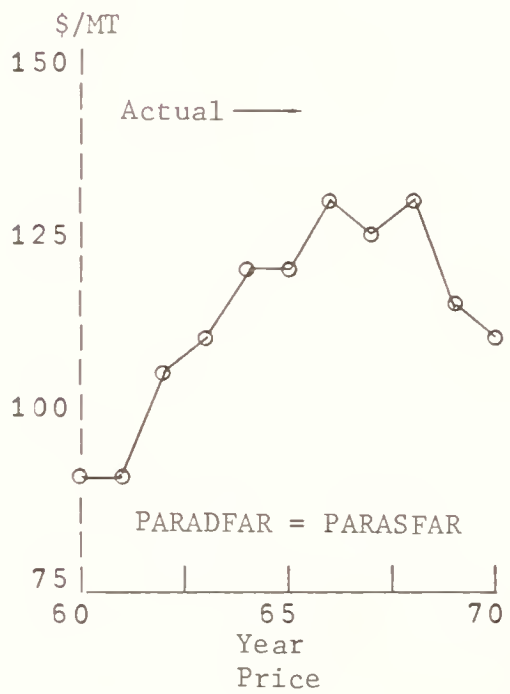
1. PARADFAR = PARASFAR

2. PARADFAR = PFAOEXR

Where QDD = Domestic disappearance in thousand metric tons milled rice
QS = Domestic production in thousand metric tons milled rice
PARADFAR = FAO round grain rice price index, 1957-59 = 100
PARASFAR = FAO round grain rice price index, 1957-59 = 100
PFAOEXR = FAO round grain rice price index, 1957-59 = 100
PWI = Import price wheat in U.S. dollars per metric ton
YPC = Gross domestic product per capita in U.S. dollars
POP = Population in millions
T = Years, 1960 - 60
WEATHER = Dummy; 0 = good, 1 = bad







NEAR EAST SHORT GRAIN

NEPAL

I. Disappearance

1. $QDD = -831.46 - \underset{(.42)}{1.0017PNEPDFAR} + \underset{(2.43)}{1.1066QS} + \underset{(.84)}{37.435POP}$

$R^2 = .67$ S = 66.52 Data = 1960-72

II. Production

1. $QS = 479.89 + \underset{(.52)}{.7919PNEPSFAR} + \underset{(2.02)}{.697YIELD} + \underset{(.52)}{.013FERT}$

$R^2 = .69$ S = 37.05 Data = 1960-72

III. Price Relationships

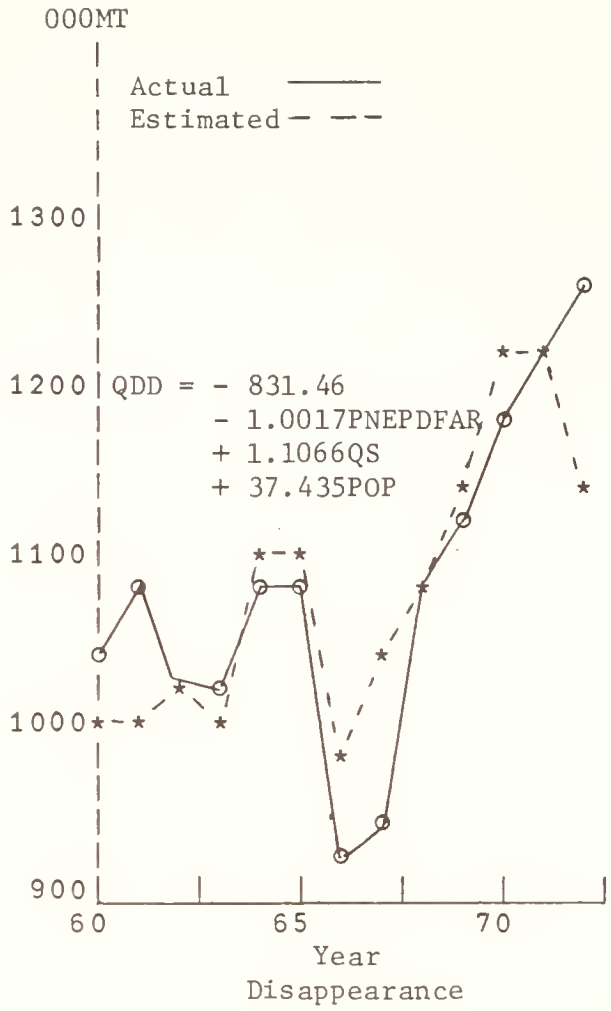
1. $PNEPSFAR = -21.09 + \underset{(9.30)}{1.009PNEPDFAR}$

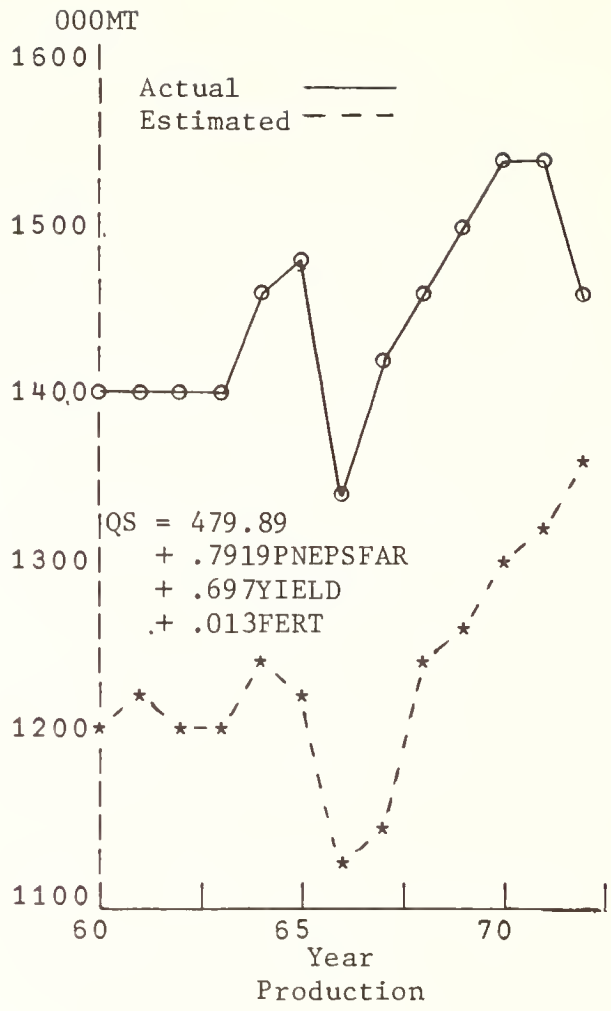
$R^2 = .89$ S = 4.70 Data = 1960-72

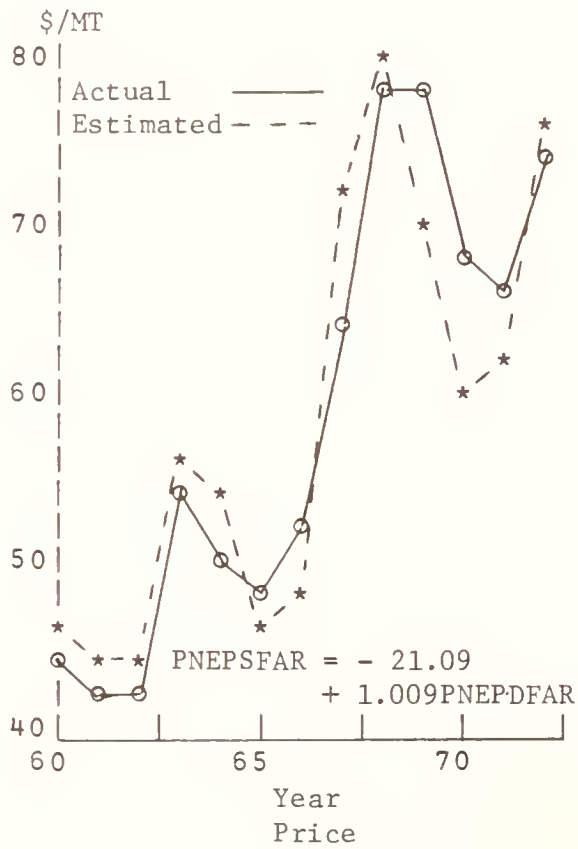
2. $PNEPDFAR = 27.51 + \underset{(3.04)}{.313PTHAEXH}$

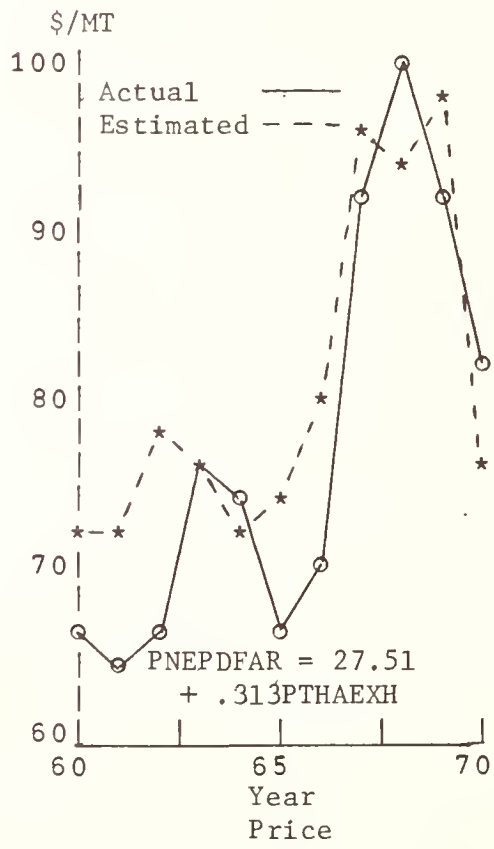
$R^2 = .46$ S = 9.70 Data = 1960-70

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PNEPDFAR = Farm price high quality, U.S. dollars per metric ton
- PNEPSFAR = Farm price low quality, U.S. dollars per metric ton
- PTHAEXH = High quality export price, Thailand, U.S. dollars per metric ton
- POP = Population in millions
- FERT = Fertilizer consumed in metric tons
- YIELD = Yield in kilograms per hectare


000MT
Actual
Estimated
1300
1200
1100
1000
900
QDD = - 831.46
- 1.0017PNEPDFAR
+ 1.1066QS
+ 37.435POP
60
65
70
Year
Disappearance


000MT
1600
Actual
Estimated
1500
1400
1300
1200
1100
QS = 479.89
+ .7919PNEPSFAR
+ .697YIELD
+ .013FERT
60
65
70
Year
Production


$/MT
80
Actual
Estimated
70
60
50
40
PNEPSFAR = - 21.09
+ 1.009PNEPDFAR
60
65
70
Year
Price


$/MT
100
Actual
Estimated
90
80
70
60
PNEPDFAR = 27.51
+ .313PTHAEXH
60
65
70
Year
Price

OCEANIA

I. Disappearance

1. $QDD = [-10.94 - \underset{(2.38)}{.02245}POCEDIMP + \underset{(6.34)}{.4040}T]POP$

$R^2 = .83$ S = .0006 Data = 1960-70

II. Production

(none)

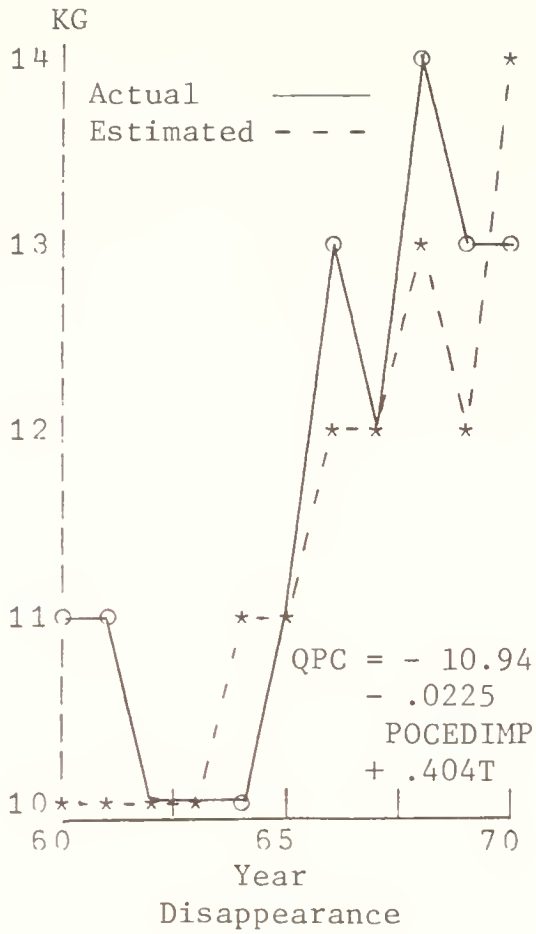
III. Price Relationships

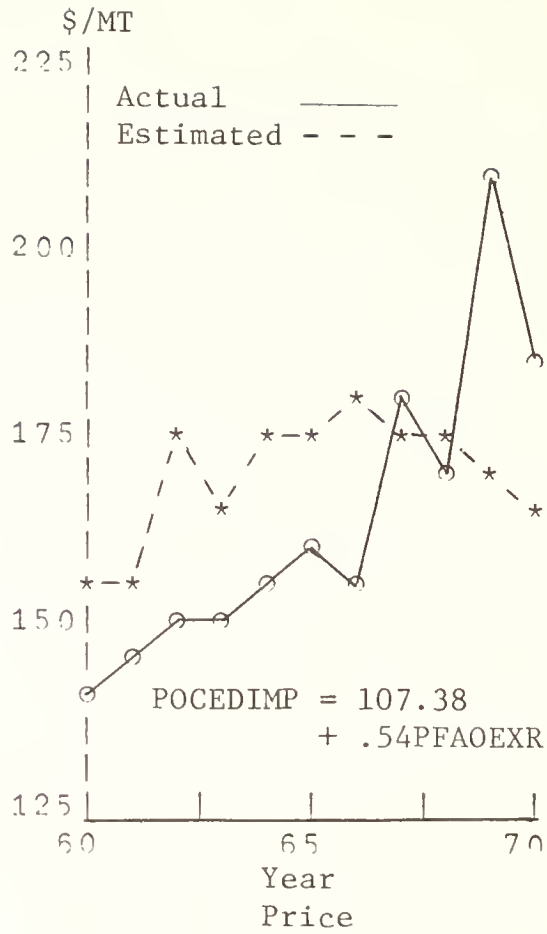
1. $POCEDIMP = 107.38 + \underset{(N.A.)}{.54}PFAOEXR$

$R^2 = N.A.$ S = N.A. Data = 1960-70

Where:

QDD	=	Domestic disappearance in thousand metric tons milled rice
POCEDIMP	=	Long-medium grain import price, U.S. dollars per metric ton
PFAOEXR	=	FAO round grain rice price index, 1957-59 = 100
T	=	Years, 1960=60
POP	=	Midyear population in millions


KG
14
13
12
11
10
Actual
Estimated
QPC = - 10.94
- .0225
POCEDIMP
+ .404T
60
65
70
Year
Disappearance


$/MT
225
200
175
150
125
Actual
Estimated
POCEDIMP = 107.38
+ .54PFAOEXR
60
65
70
Year
Price

PAKISTAN

I. Disappearance

1. $QDD = [19.3683 - 10.3894PPAKDRET / PWR + .0104QS]POP$
   (1.30) (11.05)

   $R^2 = .93$ S = 1.84 Data = 1960-73

II. Production

1. $QS = 889.3615 + 3.6809PPAKSFAR + 1.8705FERT + 3.3677RAIN$
   (.51) (1.46) (.35)

   $+ .9180HA\ IR$
   (1.58)

   $R^2 = .93$ S = 175.28 Data = 1960-73

III. Price Relationships

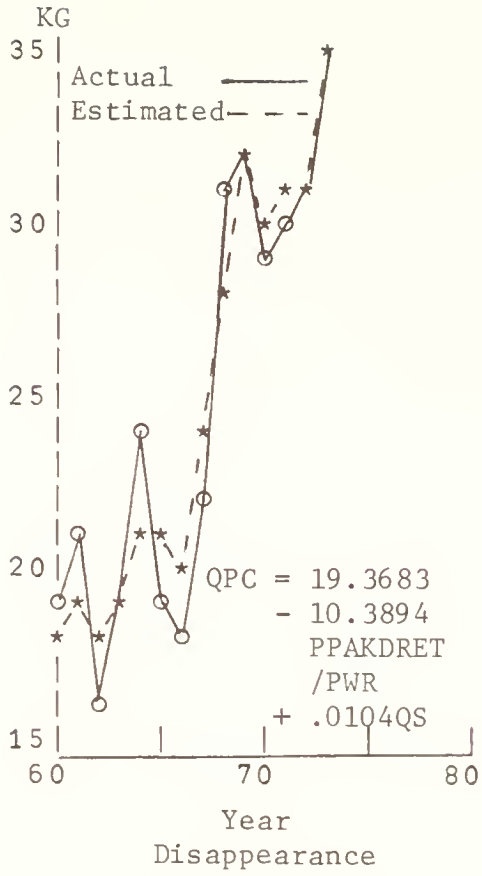
1. PPAKDRET = PPAKSFAR

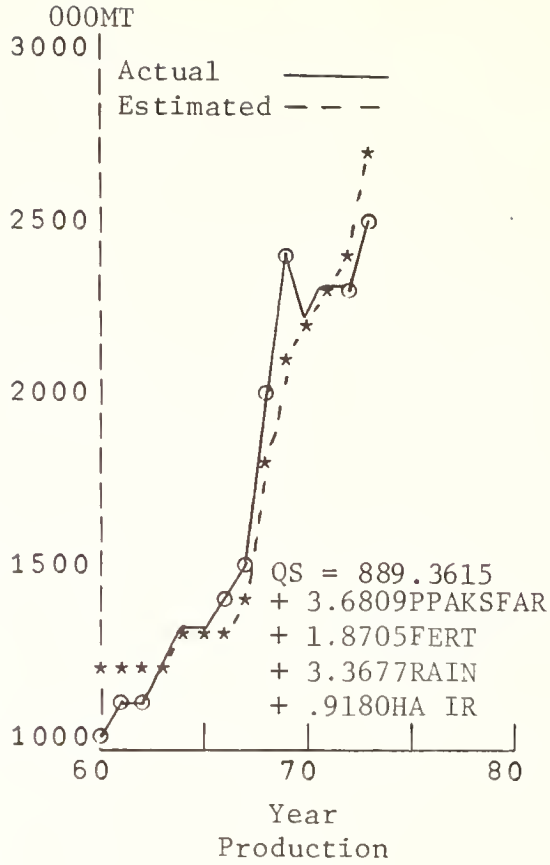
2. $PPAKDRET = 99.7354 + .2069PFAOLM - 1.0295T$
   (8.03) (4.47)

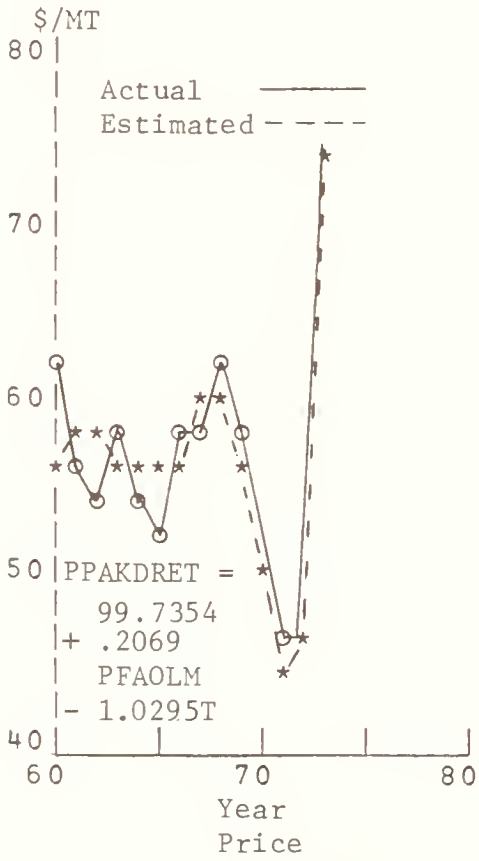
   $R^2 = .85$ S = 3.01 Data = 1960-70

Where:

QDD	=	Domestic disappearance in thousand metric tons milled rice
QS	=	Domestic production in thousand metric tons milled rice
PPAKDRET / PWR	=	Ratio between low quality Government procurement price in Begmi and Government procurement price for wheat
PPAKSFAR	=	Low quality farm price, U.S. dollars per metric ton
PFAOLM	=	FAO long-medium grain rice price index, 1957-59 = 100
POP	=	Population in millions
FERT	=	Fertilizer consumed in thousand metric tons
RAIN	=	Annual rainfall in Lahore in inches
T	=	Years, 1960 = 60
HA IR	=	Thousand irrigated hectares improved varieties of rice
PPAKDRET	=	Government procurement price for "Begmi" rice in U.S. dollars per metric ton


KG
35
30
25
20
15
Actual
Estimated
QPC = 19.3683
- 10.3894
PPAKDRET
/PWR
+ .0104QS
60
70
80
Year
Disappearance


000MT
3000
2500
2000
1500
1000
Actual
Estimated
QS = 889.3615
+ 3.6809PPAKSFAR
+ 1.8705FERT
+ 3.3677RAIN
+ .9180HA IR
60
70
80
Year
Production


$/MT
80
70
60
50
40
Actual
Estimated
PPAKDRET =
99.7354
+ .2069
PFAOLM
- 1.0295T
60
70
80
Year
Price

PHILIPPINES

I. Disappearance

1. $QDD = 322.6756 - 6.7657PPHIDFAR + .0473YPC + 89.4900POP$
(1.23) (.42) (3.56)

$R^2 = .91$ S = 132.66 Data = 1960-71

II. Production

1. $QS = 2348.46 + 26.681PPHISFAR - 41.154PCF + 6.873FERT$
(3.27) (3.73) (9.47)

$R^2 = .92$ S = 121.91 Data = 1960-71

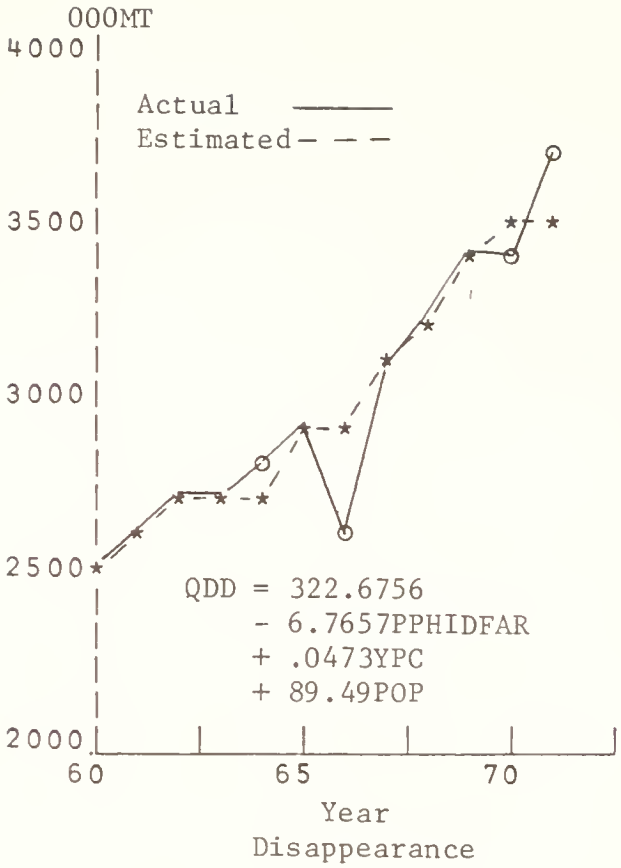
III. Price Relationships

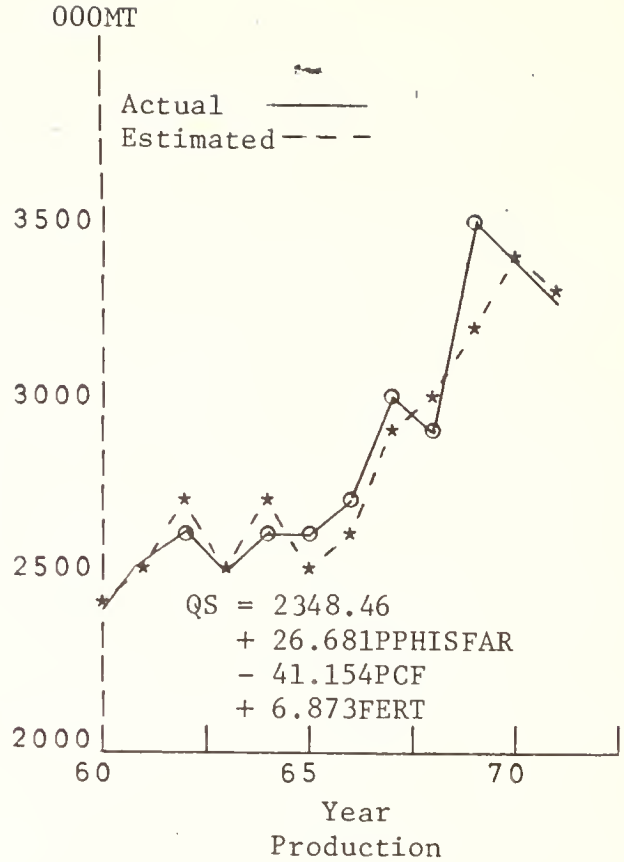
1. PPHIDFAR = PPHISFAR

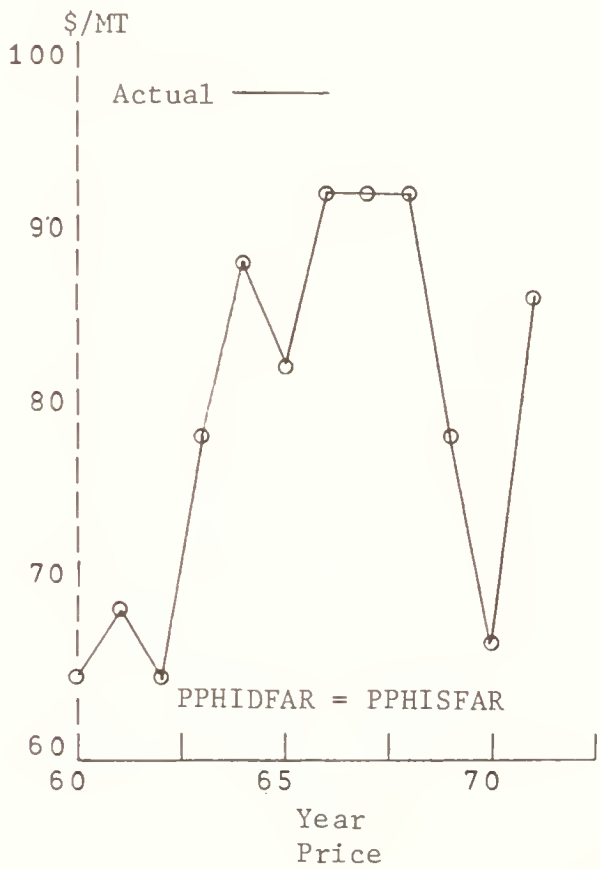
2. PPHIDFAR = FIXED

Where:

QDD	=	Domestic disappearance in thousand metric tons milled rice
QS	=	Domestic production in thousand metric tons milled rice
PPHIDFAR	=	Long grain farm price, U.S. dollars per metric ton
PPHISFAR	=	Long grain farm price, U.S. dollars per metric ton
PCF	=	Farm price corn, U.S. dollars per metric ton
YPC	=	Income per capita, thousand U.S. dollars
POP	=	Population in millions
FERT	=	Fertilizer in thousand metric tons







PHILIPPINES

SINGAPORE

I. Disappearance

1. $QDD = [.1056 - \underset{(1.58)}{.00013}PSGPDRET + \underset{(3.89)}{.00003}YPC]POP$

$R^2 = .66$ S = .0069 Data = 1960-72

II. Production

(none)

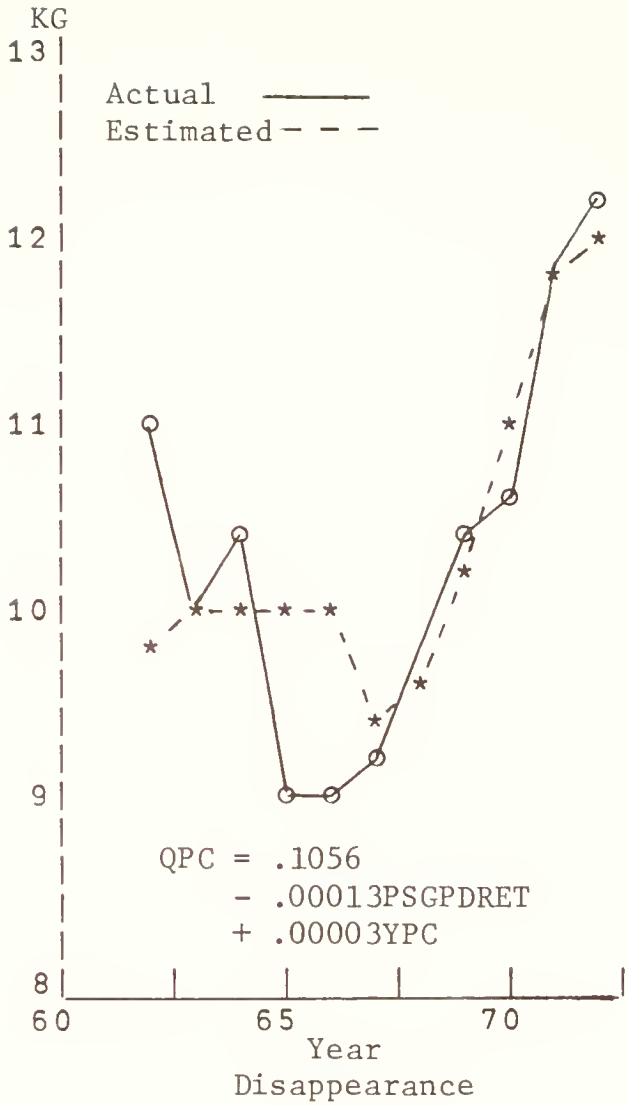
III. Price Relationships

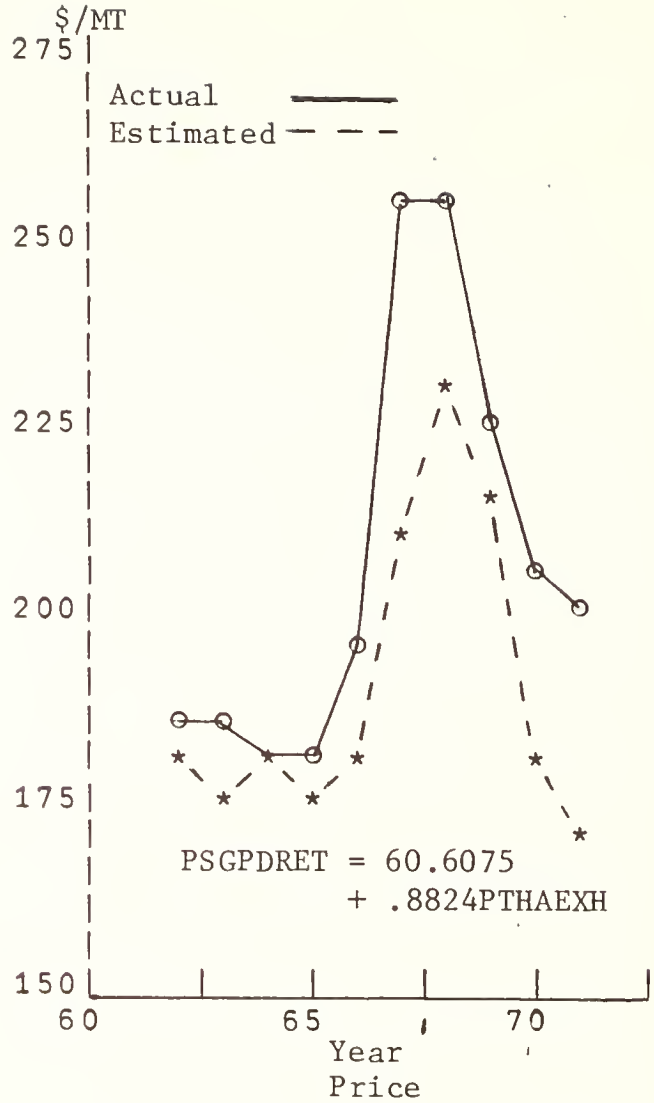
1. $PSGPDRET = 60.6075 + \underset{(6.56)}{.8824}PTHAEXH$

$R^2 = .83$ S = 11.80 Data = 1962-71

Where:

QDD	=	Domestic disappearance in thousand metric tons milled rice
PSGPDRET	=	Long grain retail price, U.S. dollars per metric ton
PTHAEXH	=	Long grain, Thailand, export price, U.S. dollars per metric ton
YPC	=	Income per capita in U.S. dollars
POP	=	Population in thousands


KG
13
12
11
10
9
8
Actual
Estimated
QPC = .1056
- .00013PSGPDRET
+ .00003YPC
60
65
70
Year
Disappearance


$/MT
275
250
225
200
175
150
Actual
Estimated
PSGPDRET = 60.6075
+ .8824PTHAEXH
60
65
70
Year
Price

SINGAPORE

SOUTH AFRICA

I. Disappearance

1. $QDD = -247.6318 - .2021PSAFDRET + 6.09416T$
(2.53) (5.48)

$R^2 = .92$ S = 4.06 Data = 1960-70

II. Production

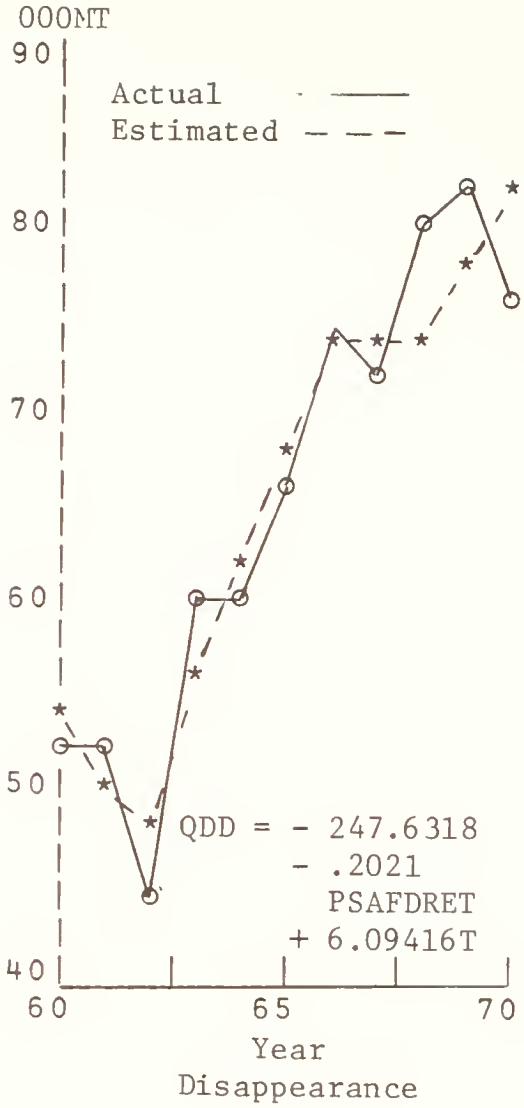
(none)

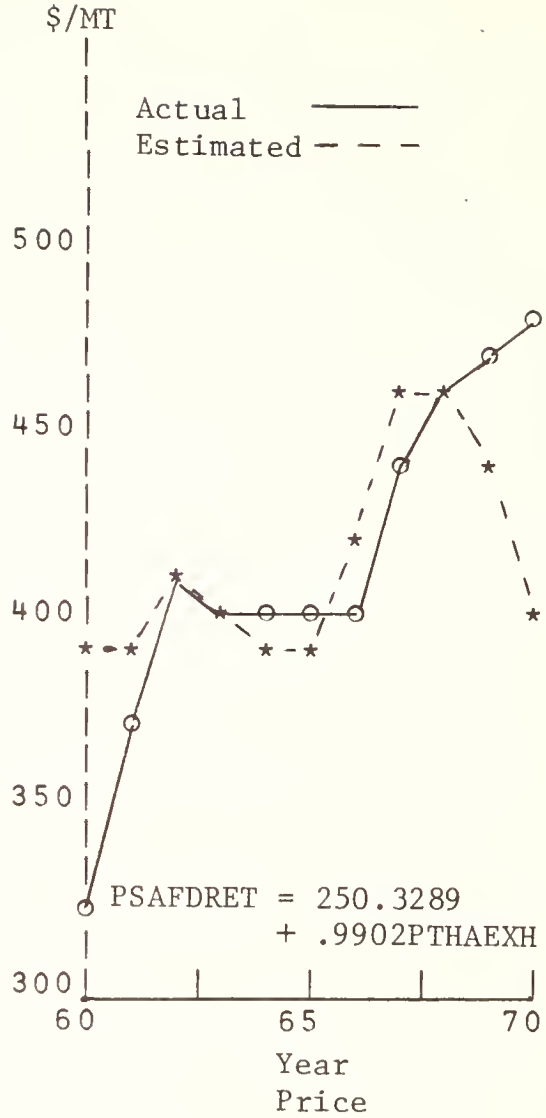
III. Price Relationships

1. $PSAFDRET = 250.3289 + .9902PTHAEXH$
(2.30)

$R^2 = .37$ S = 38.64 Data = 1960-70

Where: QDD = Domestic disappearance in thousand metric tons milled rice
PSAFDRET = Long-medium grain, high quality, retail price, U.S. dollars per metric ton
PTHAEXH = Export price rice, high quality, Thailand, U.S. dollars per metric ton
T = Years, 1960 = 60


000MT
90
80
70
60
50
40
Actual
Estimated
QDD = - 247.6318
- .2021
PSAFDRET
+ 6.09416T
60
65
70
Year
Disappearance


$/MT
500
450
400
350
300
Actual
Estimated
PSAFDRET = 250.3289
+ .9902PTHAEXH
60
65
70
Year
Price

SPAIN AND GREECE

I. Disappearance

1. $QDD = [.01574 - .000012PEEXDWHO - .00011T]POP$
   (1.72) (3.70)

$R^2 = .73$ S = .0004 Data = 1960-70

II. Production

1. $QS = 78.6965 + .2013PEEXSWHO - .4885T + 2.7284HA$
   (1.13) (.65) (4.19)

$R^2 = .75$ S = 7.56 Data = 1960-70

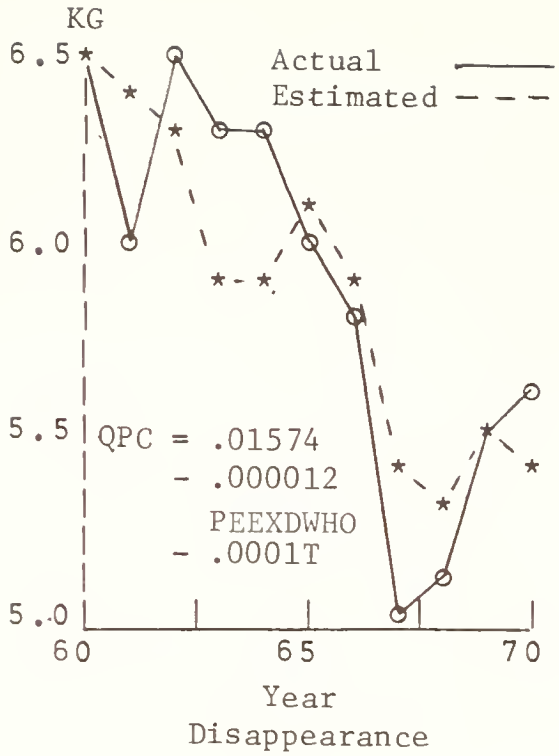
III. Price Relationships

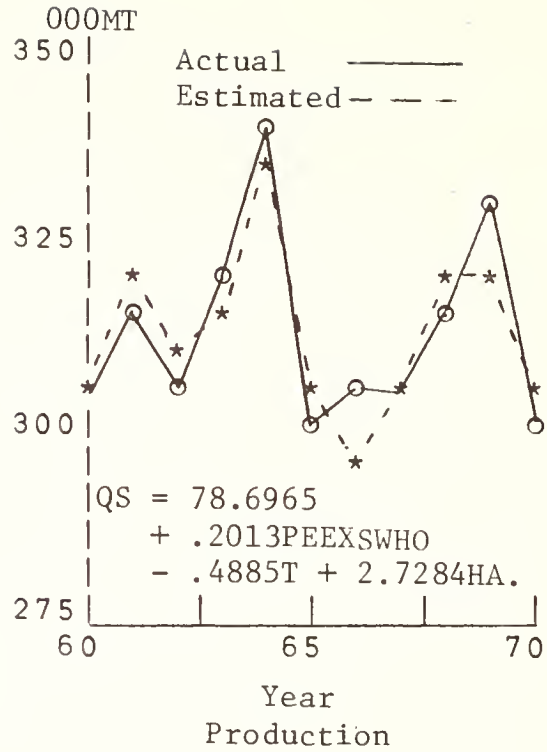
1. $PEEXSWHO = 180.85 + .262PFAOEXR$
   (N.A.)

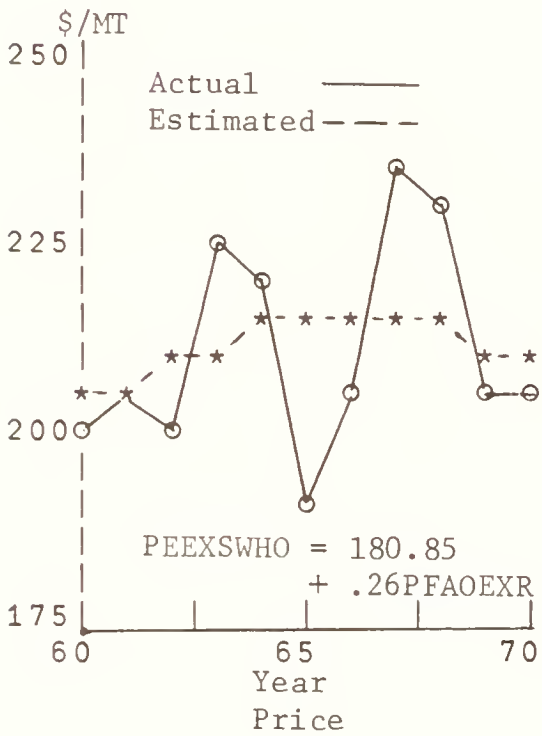
R^2 = N.A. S = N.A. Data = 1960-70

2. PEEXSWHO = PEEXDWHO

WHERE:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PEEXDWHO = Long grain wholesale price rice, U.S. dollars per metric ton
- PEEXSWHO = Long grain wholesale price rice, U.S. dollars per metric ton
- PFAOEXR = FAO round grain rice price index, 1957-59 = 100
- T = Years, 1960 = 60
- HA = Thousand hectares in rice







SPAIN AND GREECE

SRI LANKA

I. Disappearance

1. $QDD = 597.7811 - \underset{(.55)}{2.147}PCEYDEXP + \underset{(2.40)}{.5117}Y$

$R^2 = .46$ S = 144.60 Data = 1960-70

II. Production

1. $QS = - 852.3863 + \underset{(.78)}{.8925}PCEYSRET - \underset{(.83)}{32.9396}WEATHER + \underset{(4.84)}{2.4023}HA\ RI$

$R^2 = .94$ S = 48.42 Data = 1960-70

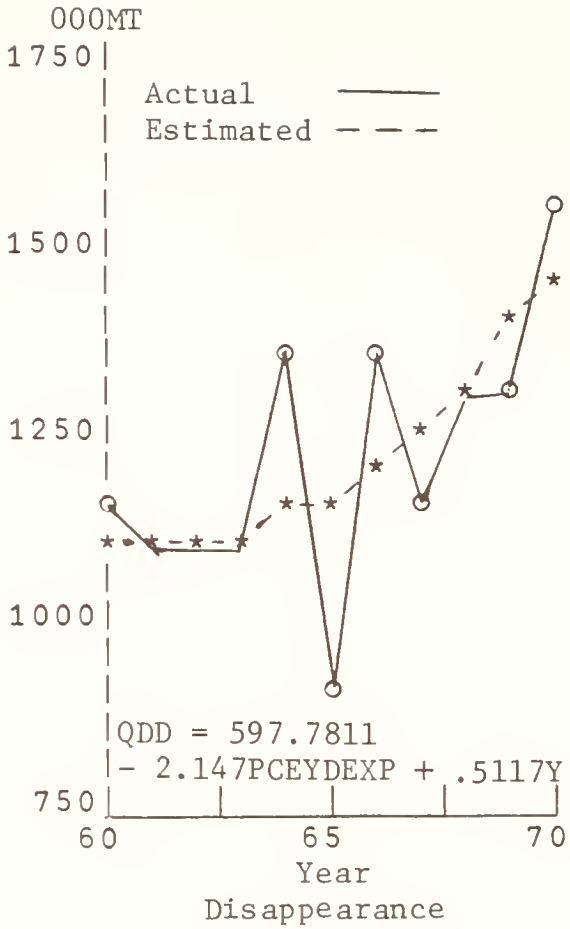
III. Price Relationships

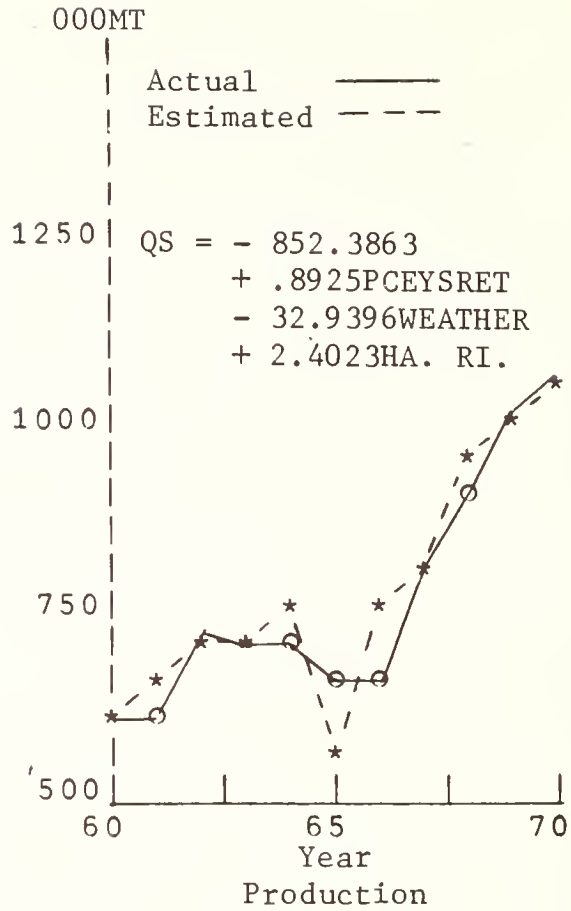
1. $PCEYSRET = 1.56 + \underset{(N.A.)}{.501}PFAOEXR$

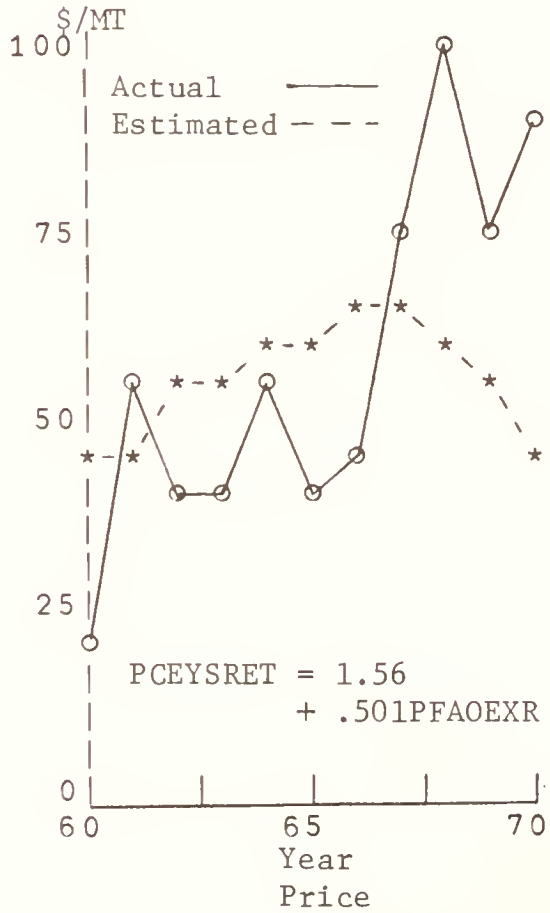
R^2 = N.A. S = N.A. Data = 1960-70

2. PCEYDEXP = PFAOEXR

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PCEYDEXP = Low quality export price, U.S. dollars per metric ton milled rice
- PCEYSRET = Low quality retail price, U.S. dollars per metric ton milled rice
- PFAOEXR = FAO round grain rice price index, 1957-59 = 100
- Y = Income in million U.S. dollars
- WEATHER = Dummy variable, 0 = good, 1 = bad
- HA RI = Area in rice in thousand hectares


000MT
1750
1500
1250
1000
750
Actual
Estimated
QDD = 597.7811
- 2.147PCEYDEXP + .5117Y
60
65
70
Year
Disappearance


000MT
1250
1000
750
500
Actual
Estimated
QS = - 852.3863
+ .8925PCEYSRET
- 32.9396WEATHER
+ 2.4023HA. RI.
60
65
70
Year
Production


$/MT
100
75
50
25
0
Actual
Estimated
PCEYSRET = 1.56
+ .501PFAOEXR
60
65
70
Year
Price

SRI LANKA

TAIWAN

I. Disappearance

1. $QDD = 1172.132 - \underset{(.32)}{.7329}PTAIDWHO + \underset{(.94)}{1.6100}PWW + \underset{(5.22)}{.1767}Y$

$R^2 = .91$ S = 58.00 Data = 1960-70

II. Production

1. $QS = 682.8649 + \underset{(3.19)}{7.8716}PTAISFAR + \underset{(.42)}{.4969}FERT$

$R^2 = .51$ S = 142.40 Data = 1960-70

III. Price Relationships

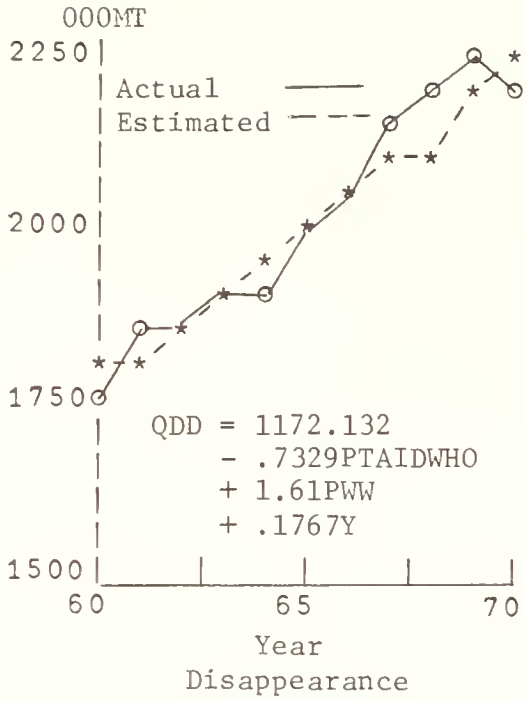
1. $PTAISFAR = - 5.4499 + \underset{(15.64)}{1.0277}PTAIDWHO$

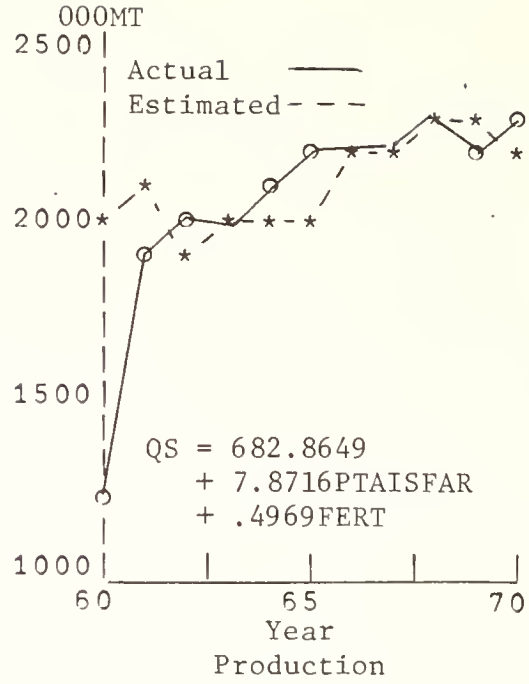
$R^2 = .96$ S = 2.82 Data = 1960-70

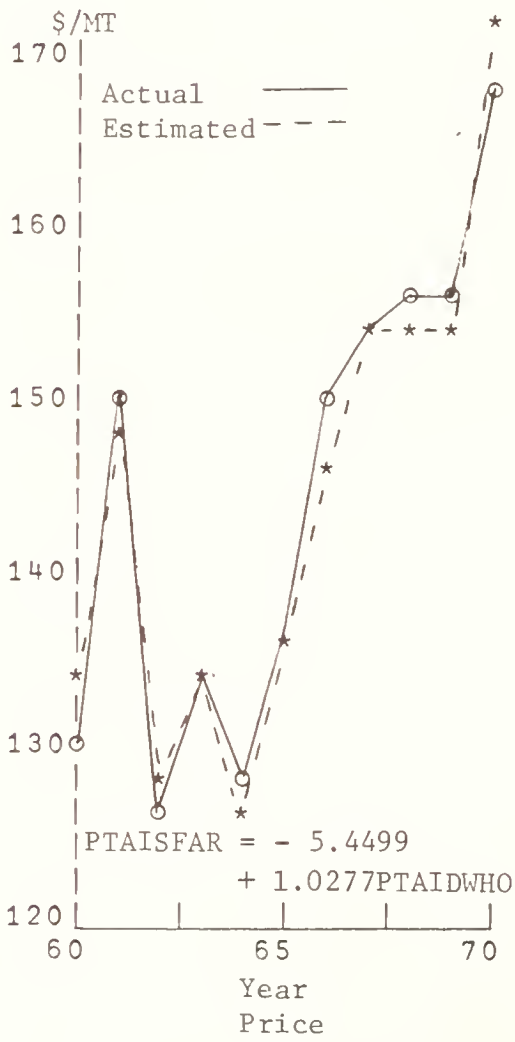
2. $PTAISFAR = 65.38 + \underset{(1.76)}{.50}PTHAEXH$

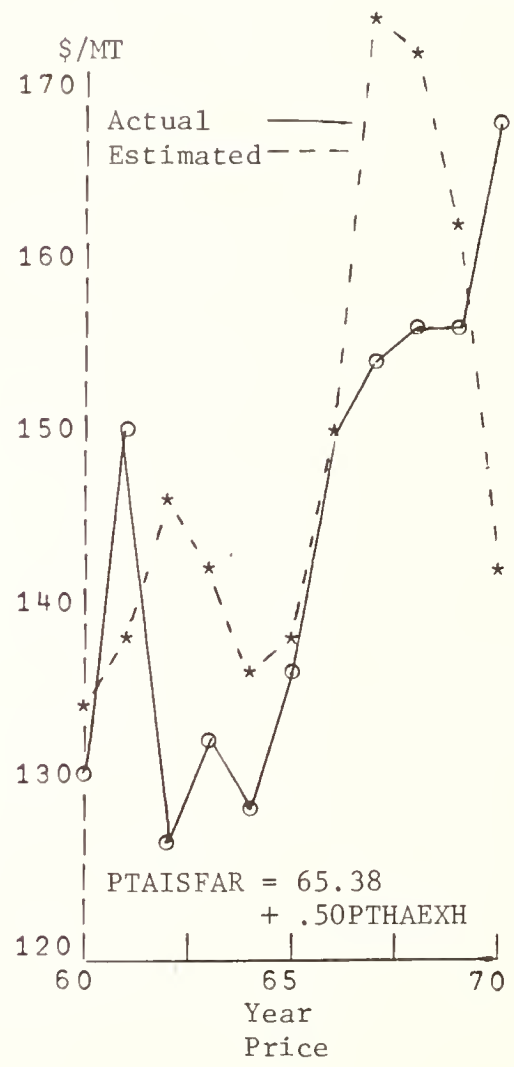
$R^2 = .26$ S = 12.91 Data = 1960-70

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PTAIDWHO = Round grain wholesale price, U.S. dollars per metric ton
- PTAISFAR = Long grain farm price, U.S. dollars per metric ton
- PTHAEXH = High quality export price, Thailand, U.S. dollars per metric ton
- Y = Million U.S. dollars
- FERT = Thousand metric tons fertilizer
- PWW = Wholesale price wheat, U.S. dollars per metric ton


000MT
2250
2000
1750
1500
Actual
Estimated
QDD = 1172.132
- .7329PTAIDWHO
+ 1.61PWW
+ .1767Y
60
65
70
Year
Disappearance


000MT
2500
2000
1500
1000
Actual
Estimated
QS = 682.8649
+ 7.8716PTAISFAR
+ .4969FERT
60
65
70
Year
Production


$/MT
170
160
150
140
130
120
Actual
Estimated
PTAISFAR = - 5.4499
+ 1.0277PTAIDWHO
60
65
70
Year
Price


$/MT
170
160
150
140
130
120
Actual
Estimated
PTAISFAR = 65.38
+ .50PTHAEXH
60
65
70
Year
Price

TAIWAN

THAILAND

I. Disappearance[a/]

1. $QDD = -618.72 - 10.00PTHADWHO + .7415QS + 61.550POP$
   (N.A.) (4.17) (1.62)

   $R^2 = .87$ S = 365.24 Data = 1960-72

II. Production

1. $QS = -5931.1456 + 19.206PTHASWHO + 167.749T + 33.817RAIN - 117.2849DAMAGE$
   (1.67) (4.36) (1.42) (1.96)

   $R^2 = .82$ S = 457.96 Data = 1960-72

III. Price Relationships

1. $PFAOLM = -10.36 + .741PTHAEXH$
   (N.A.)

   R^2 = N.A. S = N.A. Data = 1960-70

2. $PTHAEXH = 47.01 + 1.112PTHAEXL$
   (5.52)

   $R^2 = .77$ S = 12.29 Data = 1960-70

3. $PTHADWHO = 8.7917 + .4565PTHAEXH$
   (6.09)

   $R^2 = .77$ S = 7.06 Data = 1960-70

4. PTHADWHO = PTHASWHO

Where:

QDD	=	Domestic disappearance in thousand metric tons milled rice
QS	=	Domestic production in thousand metric tons milled rice
PTHADWHO	=	Long grain wholesale price, U.S. dollars per metric ton
PTHASWHO	=	Long grain wholesale price, U.S. dollars per metric ton
POP	=	Population in thousands
T	=	Years, 1960 = 60
RAIN	=	Rainfall in inches in Central Plains
DAMAGE	=	Crop damage as a percent of total hectares
PFAOLM	=	FAO long-medium grain rice price index, 1957-59 = 100
PTHAEXH	=	Export price high quality, Thailand, U.S. dollars per metric ton
PTHAEXL	=	Export price low quality, Thailand, U.S. dollars metric ton

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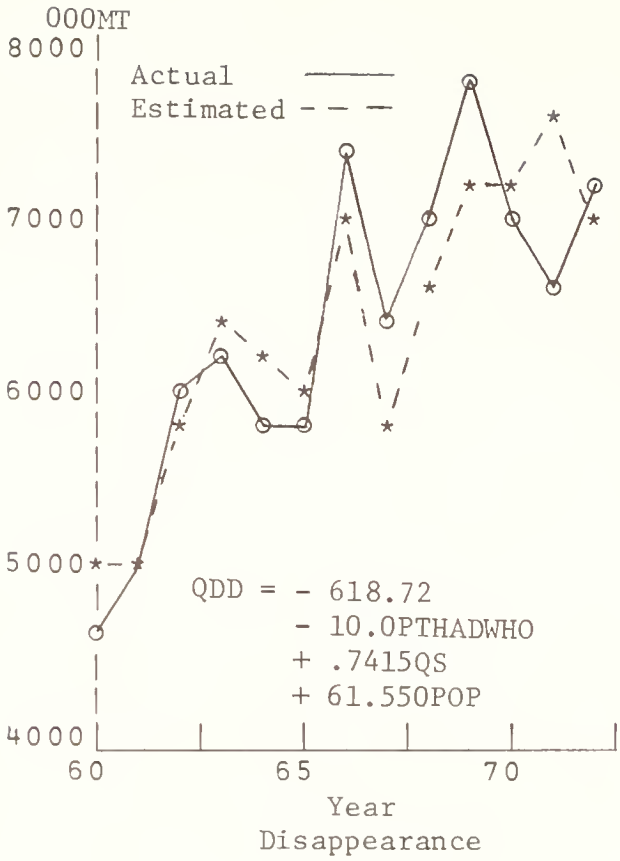
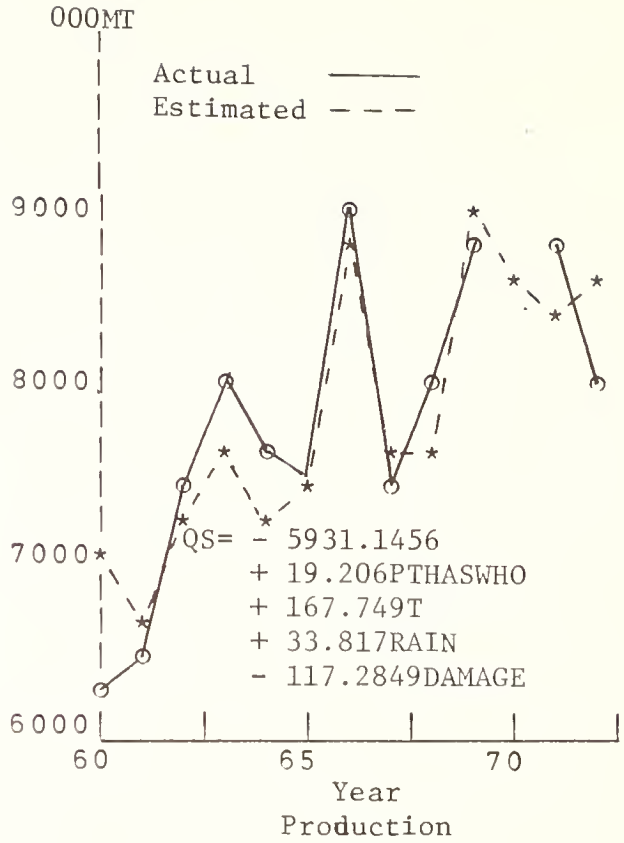
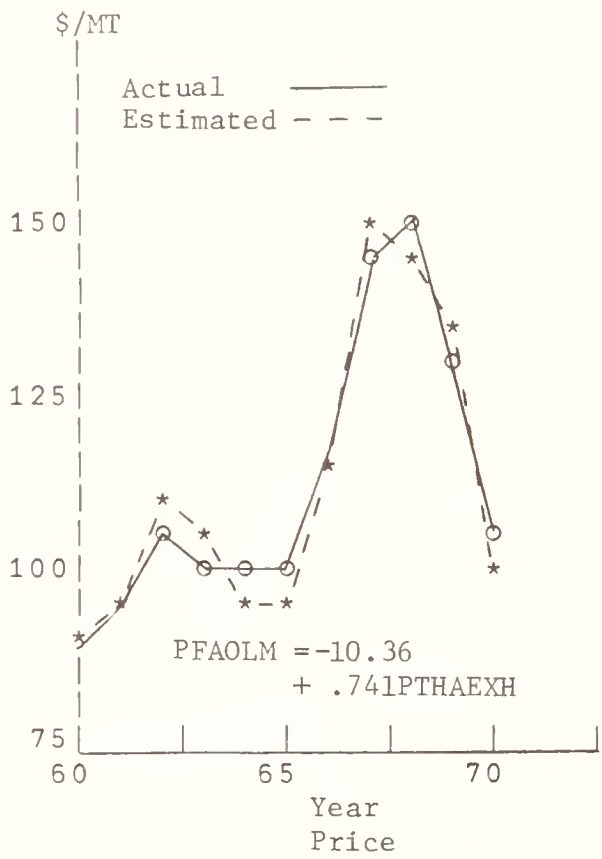
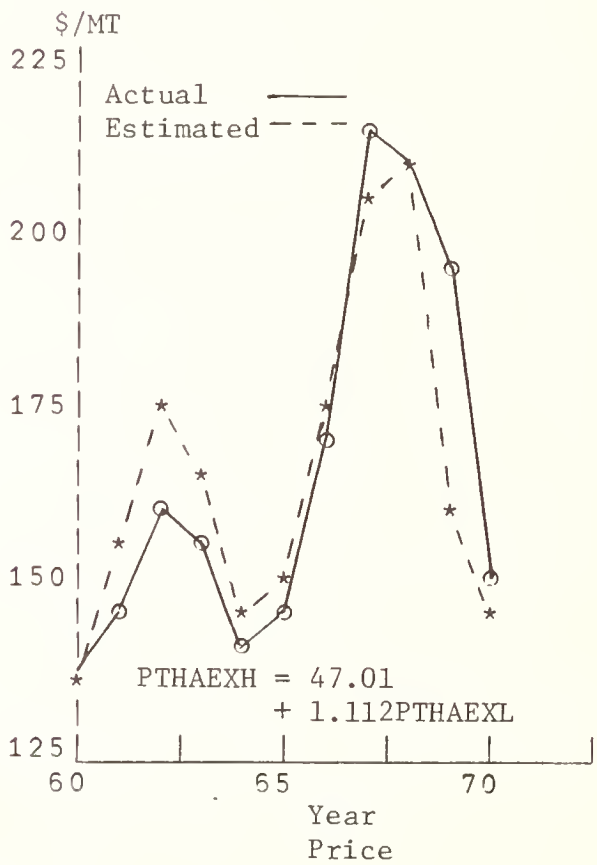
a/ Equations including price always resulted in a positive price response. Elasticity of demand was assumed at - .15 with the coefficient for price estimated using 1970/73 data. Disappearance was adjusted to remove the assumed price effect and the above equation estimated.

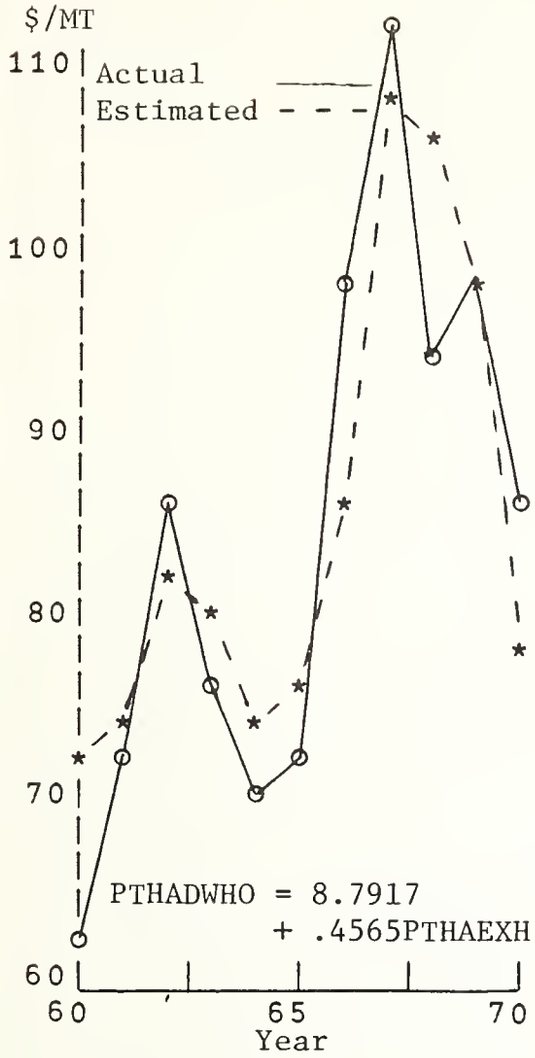

000MT
8000
7000
6000
5000
4000
Actual
Estimated
QDD = - 618.72
- 10.0PTHADWHO
+ .7415QS
+ 61.550POP
60
65
70
Year
Disappearance


000MT
9000
8000
7000
6000
Actual
Estimated
QS= - 5931.1456
+ 19.206PTHASWHO
+ 167.749T
+ 33.817RAIN
- 117.2849DAMAGE
60
65
70
Year
Production


$/MT
150
125
100
75
Actual
Estimated
PFAOLM =-10.36
+ .741PTHAEXH
60
65
70
Year
Price


$/MT
225
200
175
150
125
Actual
Estimated
PTHAEXH = 47.01
+ 1.112PTHAEXL
60
65
70
Year
Price

THAILAND


$/MT
110
100
90
80
70
60
Actual
Estimated
PTHADWHO = 8.7917
+ .4565PTHAEXH
60
65
70
Year

Price

I. Disappearance

1. $QDD = -1392.6584 - 1.0373PSVNDRET + 306.0041POP$
(.48) (3.22)

$R^2 = .76$ S = 233.08 Data = 1960-70

II. Production

1. $QS = -965.80 + 1.3PSVNSFAR + 3.06YIELD$
(N.A.) (N.A.)

R^2 = N.A. S = N.A. Data = 1960-70

III. Price Relationships

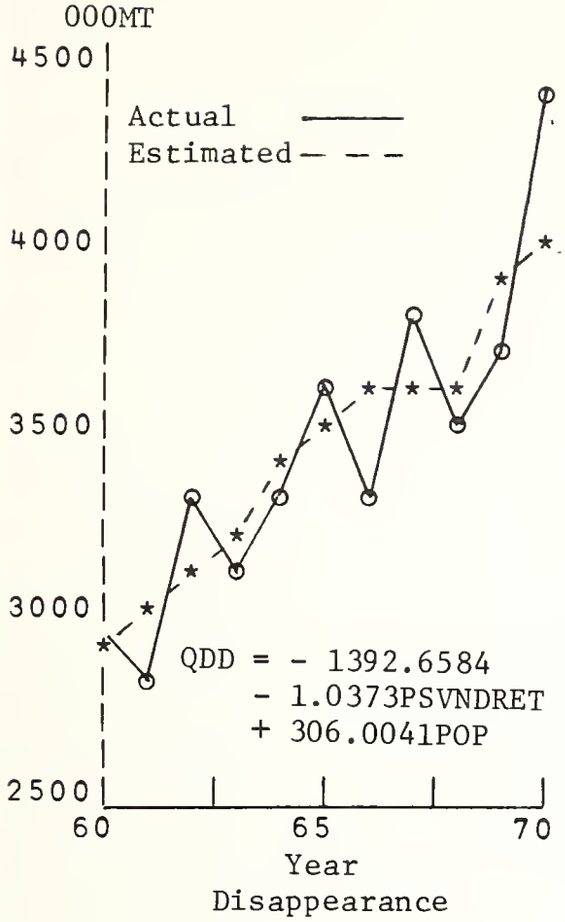
1. $PSVNSFAR = 37.7589 + .4619PSVNDRET - .5391T$
(24.45) (1.54)

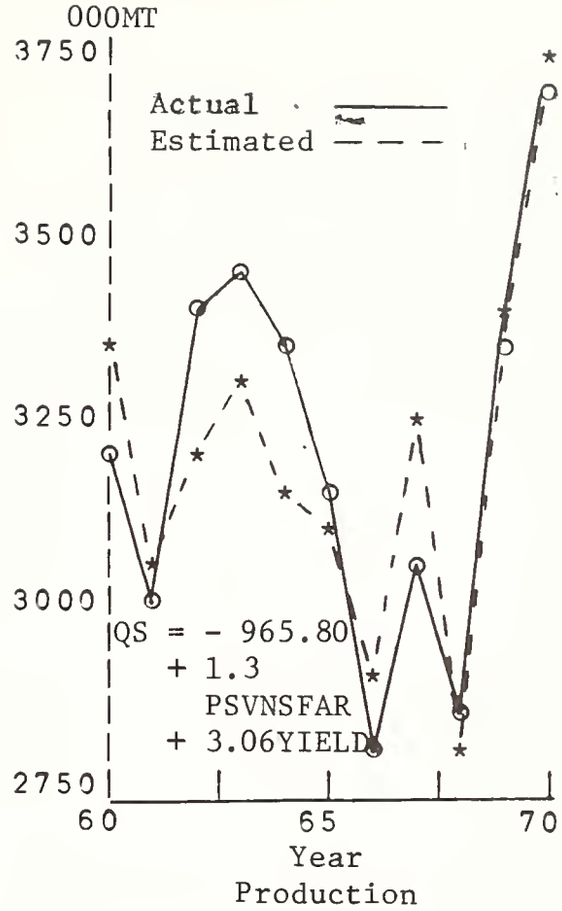
$R^2 = .99$ S = 2.10 Data = 1960-70

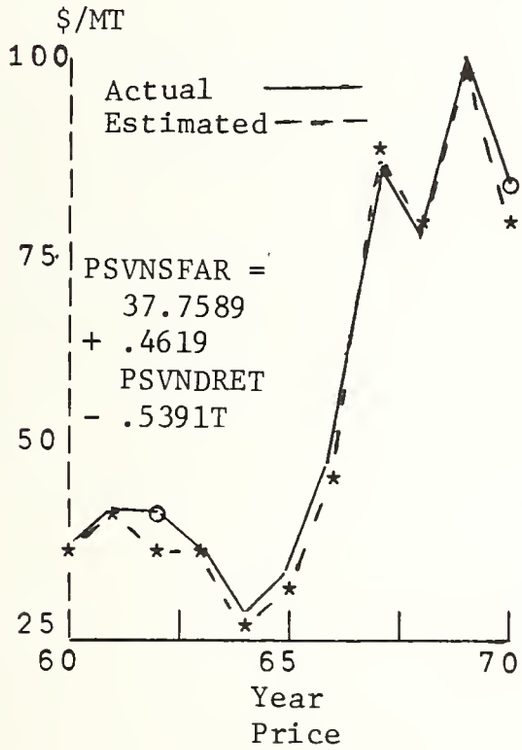
2. $PSVNDRET = -858.0200 + .5203PTHAEXL + 14.0613T$
(.96) (3.77)

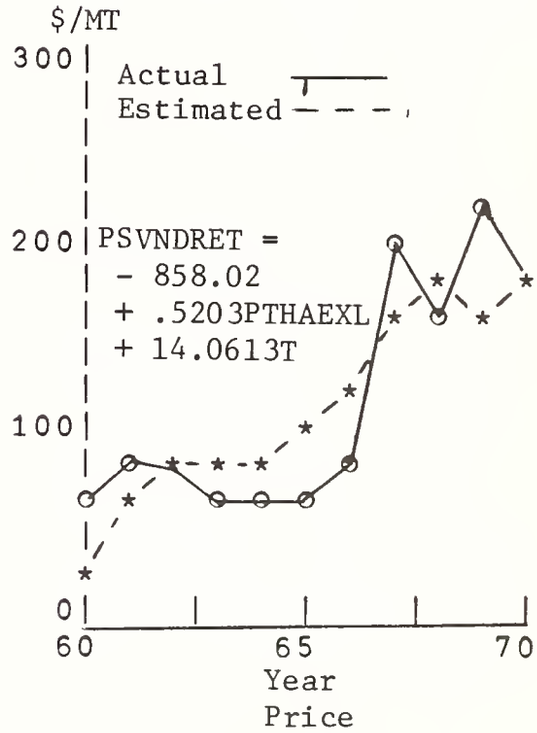
$R^2 = .70$ S = 37.27 Data = 1960-70

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- PSVNDRET = Long grain retail price, U.S. dollars per metric ton
- PSVNSFAR = Low quality farm price, U.S. dollars per metric ton
- POP = Population in millions
- T = Years, 1960 = 60
- YIELD = Yield per hectare in kilograms
- PTHAEXL = Low quality export price rice, Thailand, U.S. dollars per metric ton









VIETNAM, REPUBLIC OF

UNITED STATES LONG-MEDIUM GRAIN

I. Disappearance

1. $QDFPC = -10.67 - .000830PUSLDWHO - .0012YPC + .00364PRP + .245T + .0041QDSG$
(.12) (.46) (.17) (.55) (.12)

R^2 = N.A. S = .184 Data = 1960-73

2. $QDIPC = 4.684 - .000166PUSLDWHO + .000648YPC - .08045T - .0028QDSG$
(.57) (2.37) (1.51) (1.15)

R^2 = N.A. S = .074 Data = 1960-73

3. $QDS = -5.293 + .1135HALG1$
(21.36)

R^2 = .97 S = 1.80 Data = 1960-73

4. $QDLG = [QDFPC + QDIPC]POP + QDS$

OR

$QDLG = [-6.01157 - .000996PUSLDWHO - .000552YPC + .00364PRP + .000548HALG1 + .16455T + .0013QDRG]POP$

II. Production

1. $QSLG = -3030.354 + 1.0084PUSLSFAR + 32.7839T + 4.3597HALG - 319.8166WEAT$
(N.A.) (2.66) (6.03) (3.15)

R^2 = .93 S = 133.91 Data = 1960-73

III. Price Relationships

1. $PUSLDWHO = -75.12 + 2.663PUSLSFAR$
(7.04)

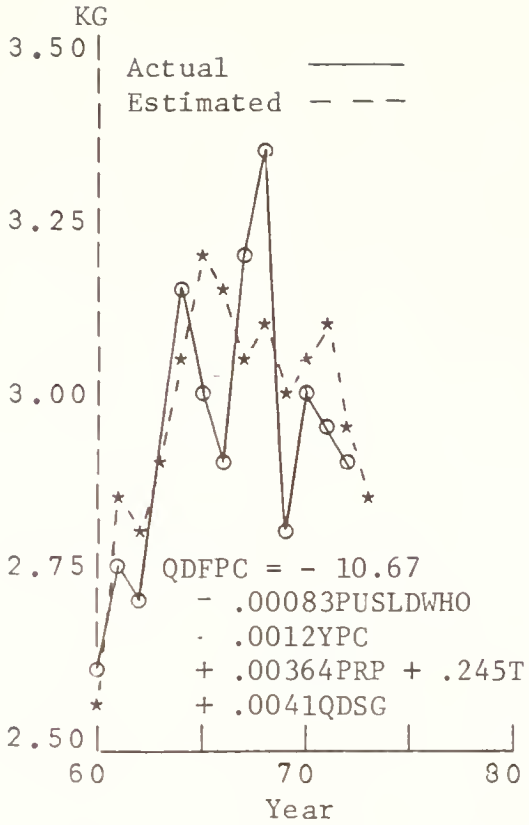
R^2 = N.A. S = 9.12 Data = 1960-73

2. $PUSLDWHO - PUSLXSUB = 1.0968 + 1.1741PTHAEXH$
(9.17)

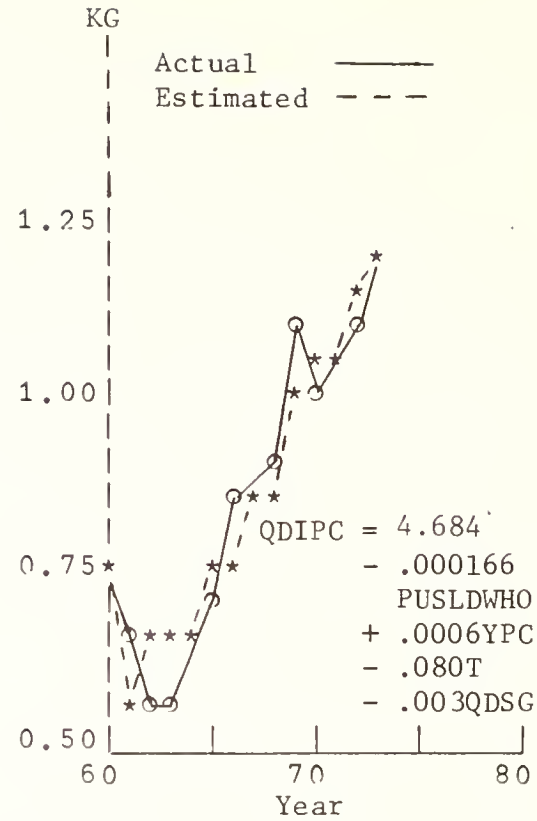
R^2 = .88 S = 29.88 Data = 1960-73

Where:

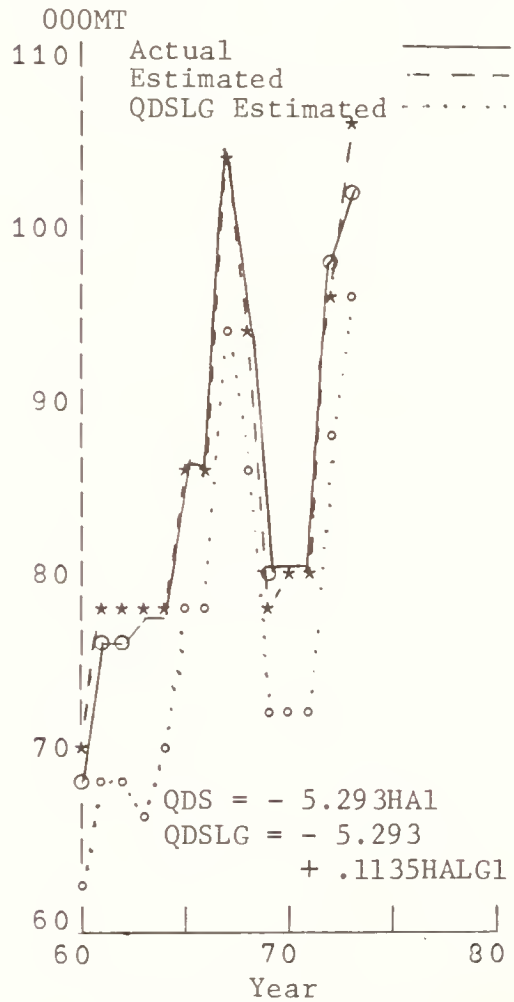
QDFPC	=	Per capita quantity of long-medium grain rice demanded for food in kilograms milled
QDIPC	=	Per capita quantity of long-medium grain rice demanded for industry in kilograms milled
QDS	=	Per capita quantity of long-medium grain rice demanded for seed in thousand metric tons milled
QDLG	=	Total quantity of long-medium grain rice demanded in thousand metric tons milled
QDRG	=	Total quantity of round grain rice demanded in thousand metric tons milled
PUSLDWHO	=	Wholesale price of long grain rice in Houston in U.S. dollars per metric ton
PUSLSFAR	=	Farm price of rice in Texas in U.S. dollars per metric ton
PRP	=	Retail price of potatoes in U.S. dollars per metric ton
YPC	=	Per capita income in U.S. dollars
T	=	Time, where 1960 = 60
HALG1	=	Thousand hectares of long-medium grain rice plus 1 year
POP	=	Midyear U.S. population in millions
HALG	=	Thousand hectares of long-medium grain rice
WEAT	=	Dummy weather, 0 = good, 1 = bad
PTHAEXH	=	High quality export price, Thailand, U.S. dollars per metric ton
PUSLXSUB	=	U.S. export subsidy on long grain rice in U.S. dollars per metric ton
QSLG	=	Total quantity of long grain rice produced in thousand metric tons milled
QDSG	=	Total quantity of short grain rice produced in thousand metric tons milled



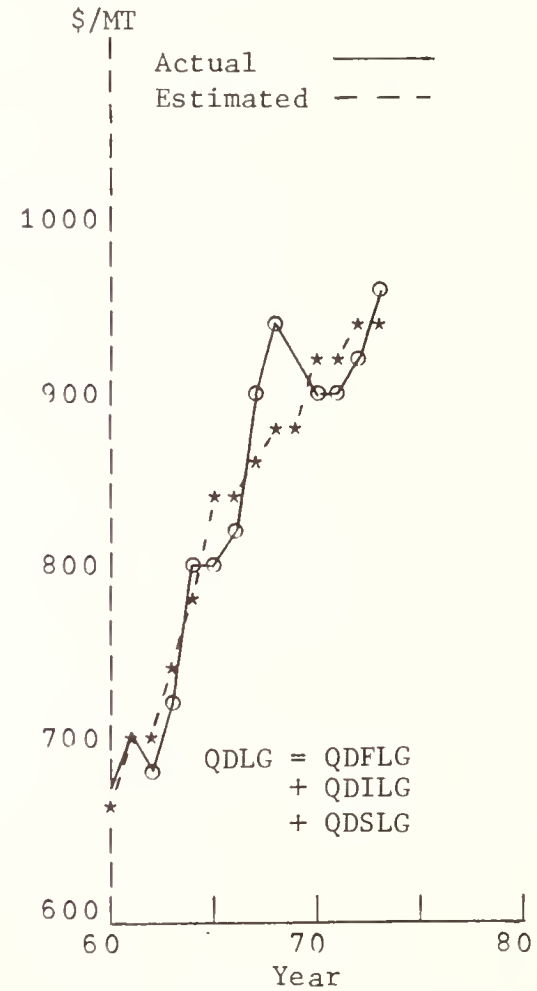
Disappearance, Food - Long Grain



Disappearance, Industry - Long Grain

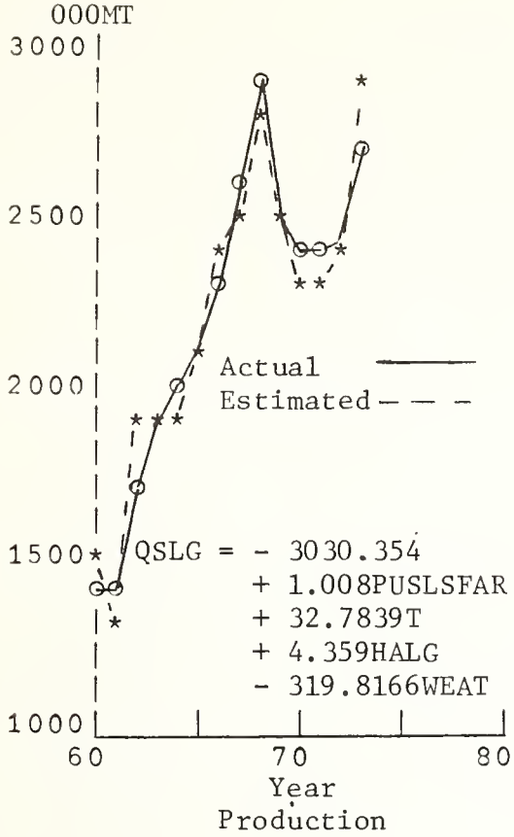


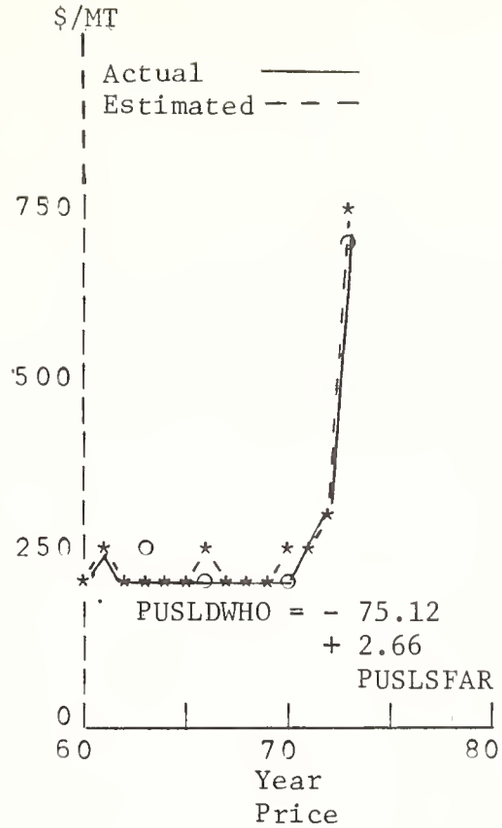
Disappearance, Seed

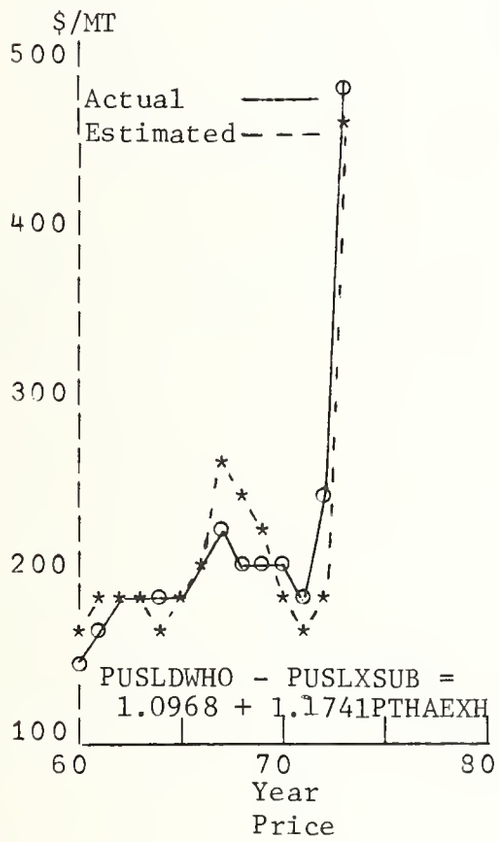


Disappearance, Long Grain

UNITED STATES LONG-MEDIUM GRAIN







UNITED STATES LONG-MEDIUM GRAIN

UNITED STATES SHORT GRAIN

I. Disappearance

1. QDFPC = 1.0930 - .00023PUSSDWHO + .000012YPC + .00124PRDB
(N.A.) (.11) (2.00)

- .00085QDLG
(1.33)

R^2 = N.A. S = .078 Data = 1960-73

2. QDIPC = .4563 - .000027PUSSDWHO + .000072YPC + .004607T
(.14) (.48) (.10)

- .001103QDLG
(1.31)

R^2 = N.A. S = .040 Data = 1960-73

3. QDS = - 5.2930 + .1135HARG1
(21.36)

R^2 = .97 S = 1.80 Data = 1960-73

4. QDRG = [QDFPC + QDIPC]POP + QDS
or
QDRG = [1.52373 - .000257PUSSDWHO + .000084YPC + .000548HARG1

+ .00124PRDB + .004607T - .001953QDLG]POP

II. Production

1. QSRG = - 25.98 + .2997PUSSSFAR + 37.18TECH - 30.63WEAT + 3.593HASG
(1.65) (3.23) (2.92) (5.39)

R^2 = N.A. S = 16.64 Data = 1960-73

III. Price Relationships

1. PUSSDWHO = - 41.43 + 2.185PUSSSFAR
(5.52)

R^2 = N.A. S = 13.49 Data = 1960-73

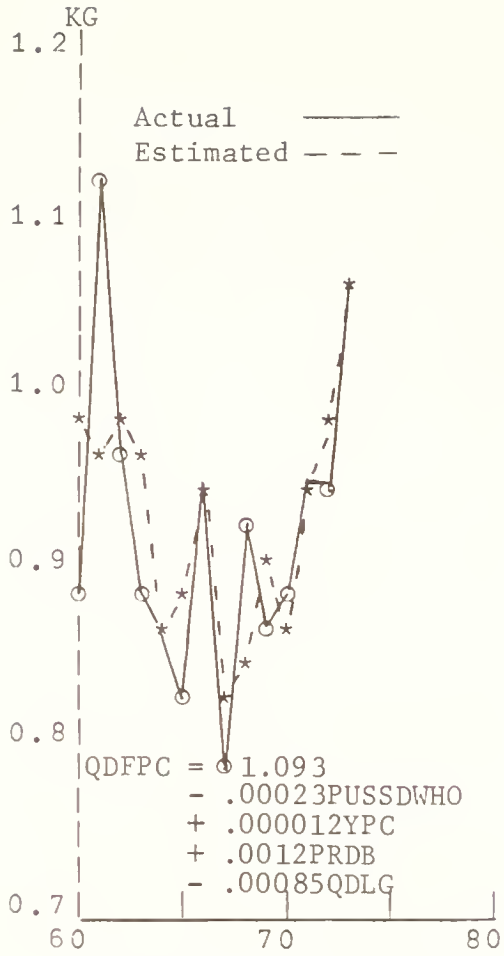
2. PUSSDWHO - PUSSXSUB = - 318.9852 + .7928PFAORG + 5.9786T
(4.55) (3.49)

R^2 = .85 S = 22.52 Data = 1960-73

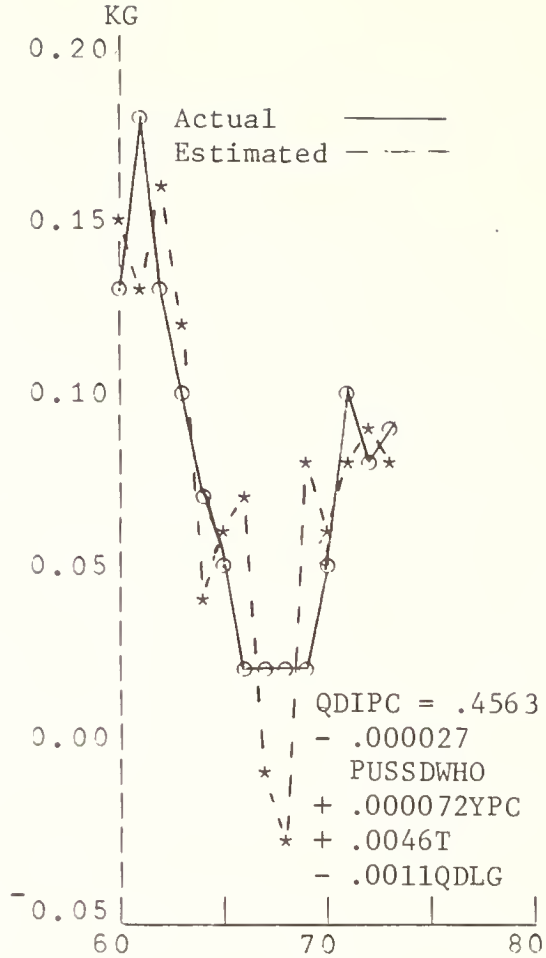
UNITED STATES SHORT GRAIN

Where:

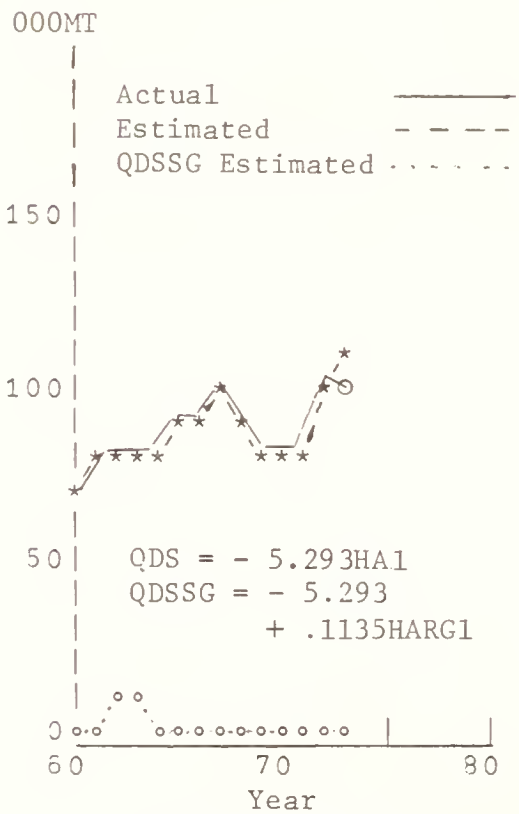
QDFPC	=	Per capita quantity of round grain rice demanded for food in kilograms
QDIPC	=	Per capita quantity of round grain rice demanded for industry in kilograms
QDS	=	Quantity of round grain rice demanded for seed in thousand metric tons milled
QDRG	=	Total quantity of round grain rice demanded in thousand metric tons milled
QDLG	=	Total quantity of long-medium grain rice demanded in thousand metric tons milled
PUSSDWHO	=	Wholesale price of round grain rice in California in U.S. dollars per metric ton
PUSSSFAR	=	Farm price of rice in California in U.S. dollars per metric ton
PRDB	=	Retail price of dry beans in U.S. dollars per metric ton
YPC	=	Per capita income in U.S. dollars
T	=	Time, where 1960 = 60
HARG1	=	Thousand hectares in round grain rice plus 1 year
POP	=	U.S. midyear population in millions
QSRG	=	Quantity produced of round grain rice in thousand metric tons milled
TECH	=	0-1 dummy variable, 1966-73 = 1
WEAT	=	Dummy variable for bad weather, 0 = good, 1 = bad
HASG	=	Hectares in round grain rice
PFAORG	=	FAO round grain price index, 1957-59 = 100
PUSSXSUB	=	U.S. export subsidy on round grain in U.S. dollars per metric ton



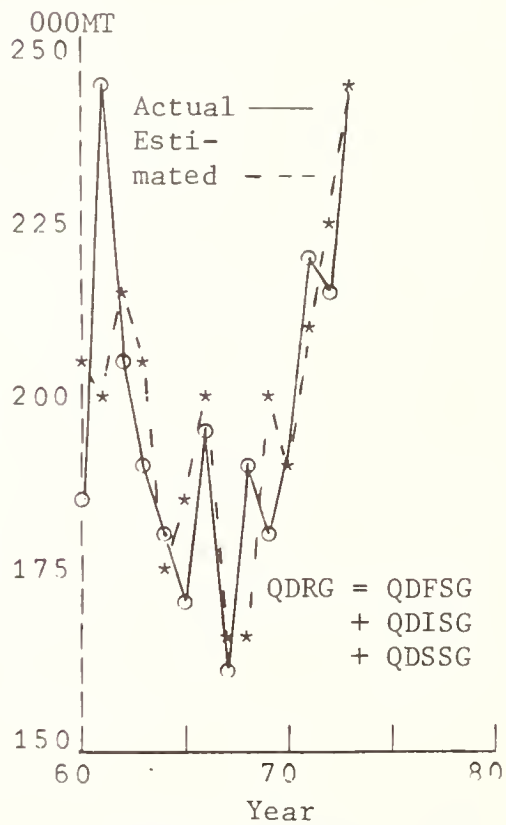
Disappearance-Food



Disappearance-Industry

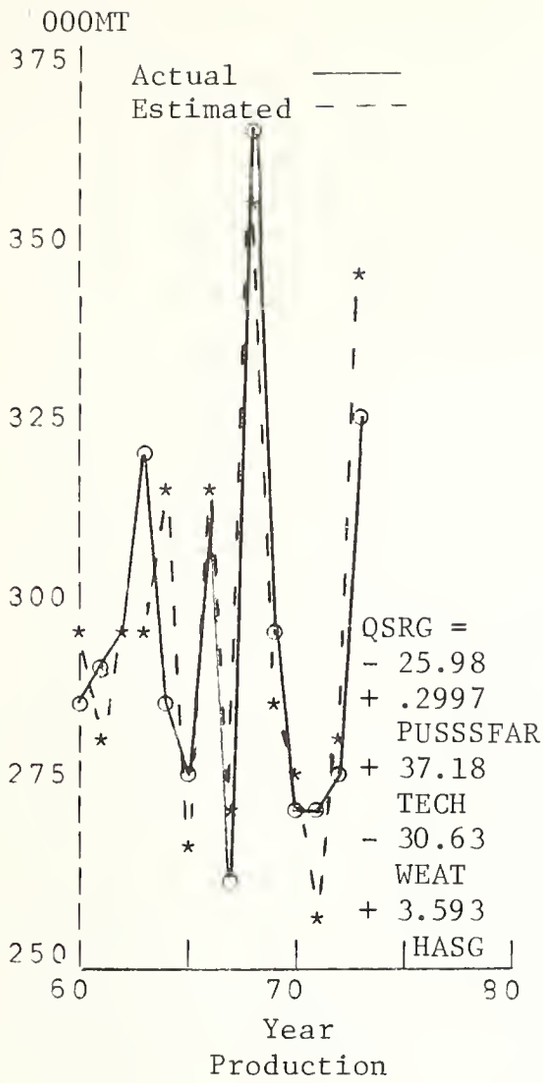


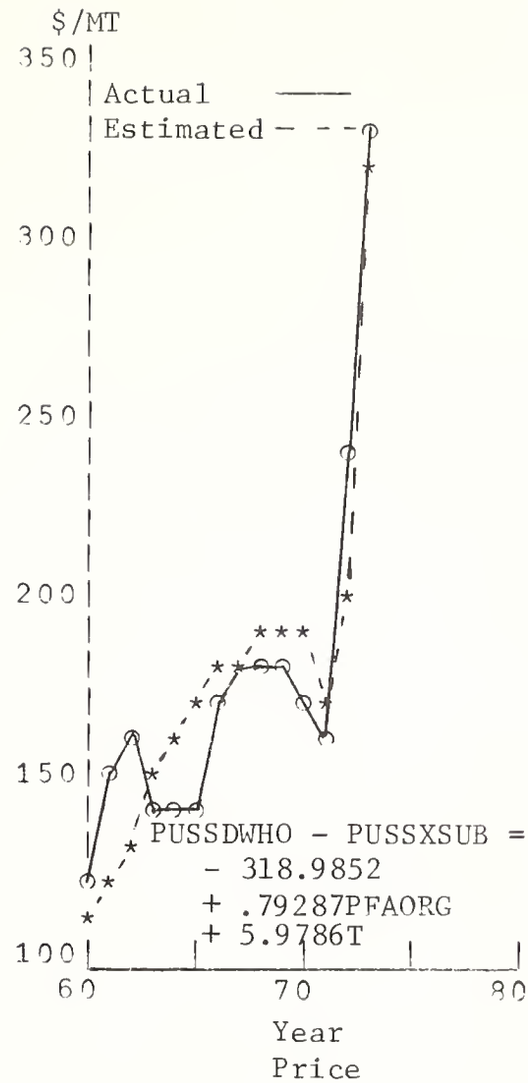
Disappearance-Seed

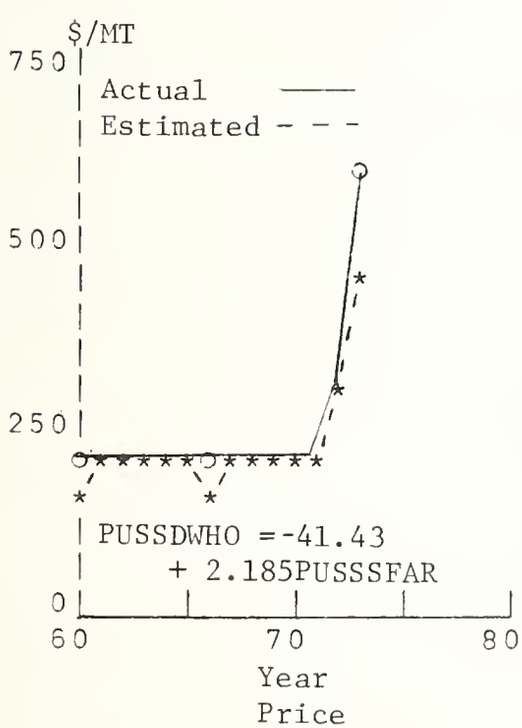


Disappearance-Short Grain

UNITED STATES - SHORT GRAIN







UNITED STATES - SHORT GRAIN

USSR AND OTHERS

I. Disappearance

1. $QDD = [2.68 - .019PEEIDRET + .0024QS]POP$
(.23) (2.16)

$R^2 = .56$ S = .0007 Data = 1960-70

II. Production

1. $QS = - 5463.585 + 10.1043PEEISRET + 86.8565T$
(1.66) (13.55)

$R^2 = .98$ S = 65.87 Data = 1960-70

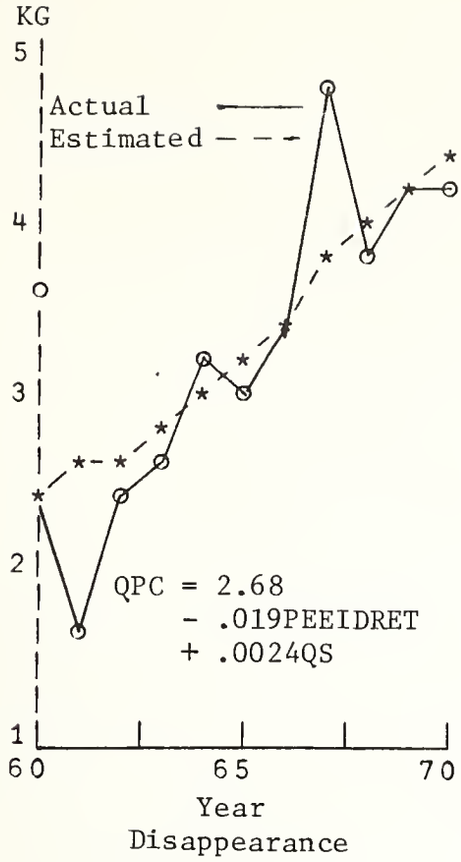
III. Price Relationships

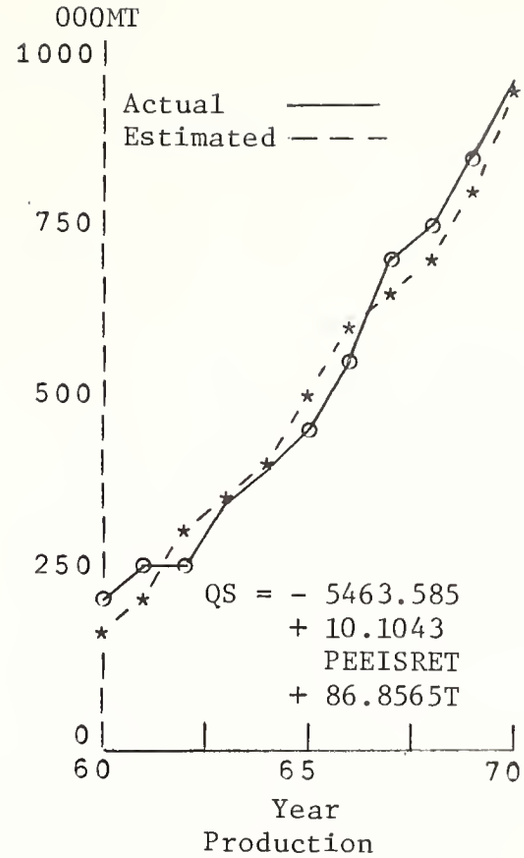
1. PEEIDRET = PEEISRET

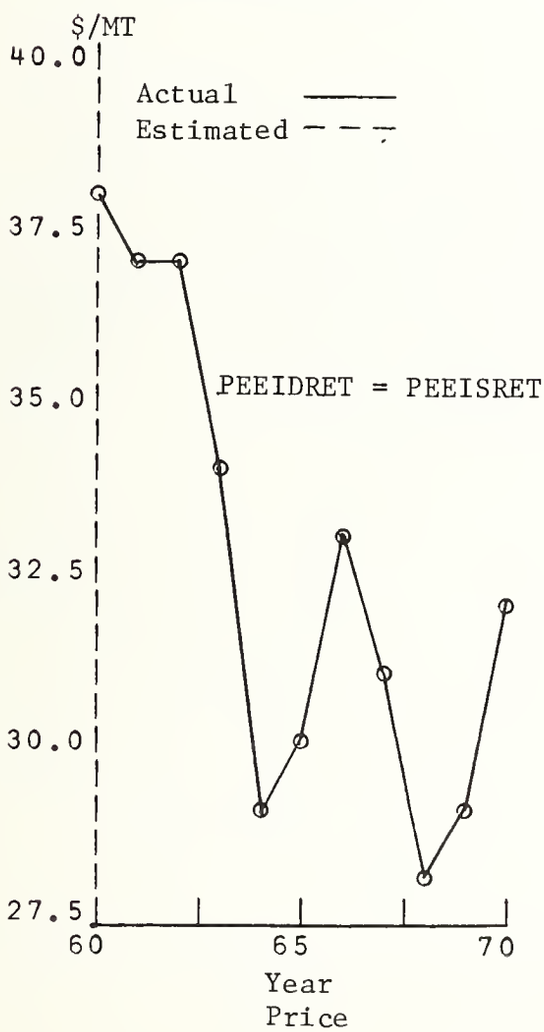
2. PEEIDRET = FIXED

Where:

QDD	=	Domestic disappearance in thousand metric tons milled rice
QS	=	Domestic production in thousand metric tons milled rice
PEEIDRET	=	Low quality retail price, U.S. dollars per metric ton
PEEISRET	=	Low quality retail price, U.S. dollars per metric ton
POP	=	Population in millions
T	=	Years, 1960 = 60







USSR AND OTHERS

WEST ASIA LONG GRAIN

I. Disappearance

1. $QDD = [12.54 - \underset{(2.11)}{.028}PWASDIMP + \underset{(4.63)}{.0126}QS]POP$

$R^2 = .85$ $S = .0007$ Data = 1960-70

II. Production

1. $QS = - 1346.68 + \underset{(1.27)}{2.225}PWASSIMP + \underset{(1.42)}{29.097}T$

$R^2 = .87$ $S = 72.26$ Data = 1960-70

III. Price Relationships

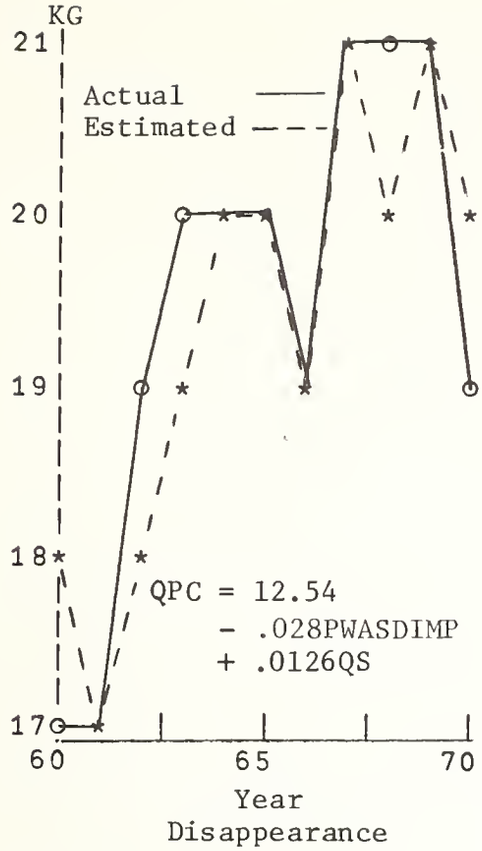
1. $PWASSIMP = 1.7676 + \underset{(4.06)}{1.0564}PTHAEXH$

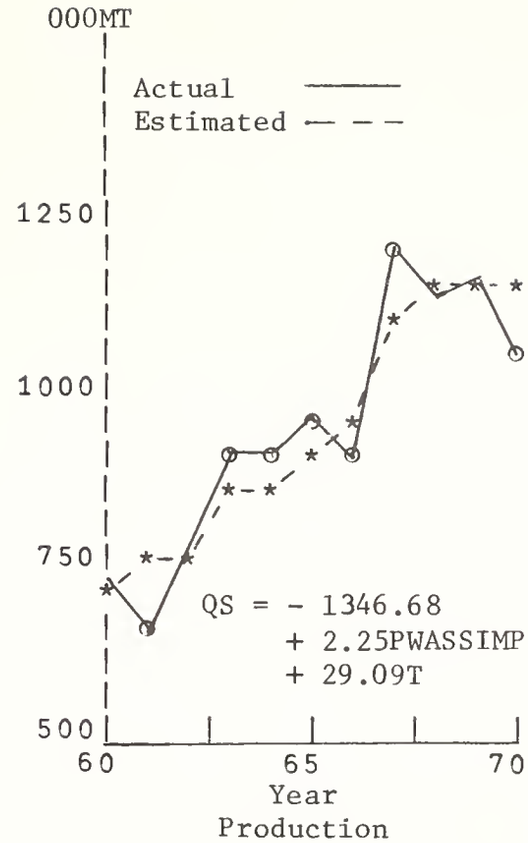
$R^2 = .65$ $S = 23.36$ Data = 1960-70

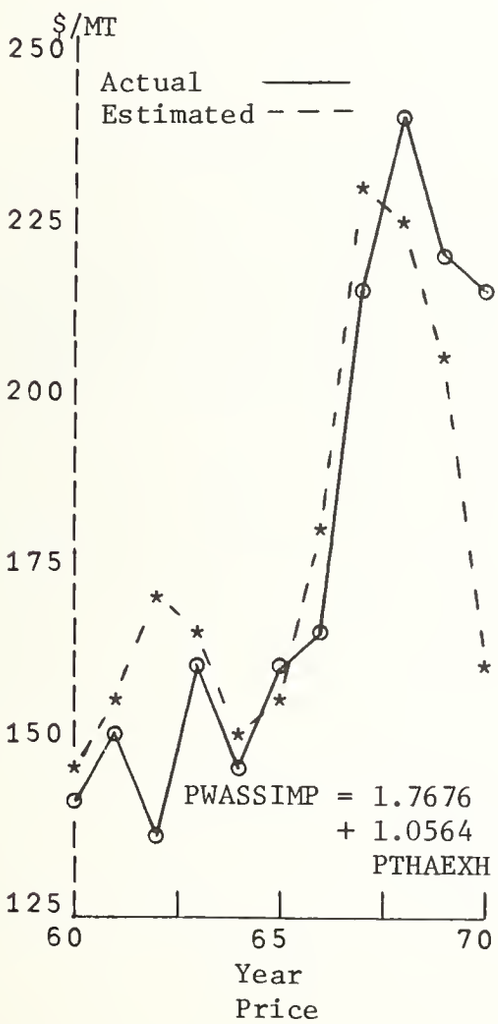
2. PWASSIMP = PWASDIMP

Where:

QDD	=	Domestic disappearance in thousand metric tons milled rice
QS	=	Domestic production in thousand metric tons milled rice
PWASDIMP	=	Long grain import price, U.S. dollars per metric ton
PWASSIMP	=	Long grain import price, U.S. dollars per metric ton
PTHAEXH	=	High quality export price, Thailand, U.S. dollars per metric ton
T	=	Years, 1960-60
POP	=	Population in millions







WEST ASIA LONG GRAIN

WESTERN HEMISPHERE EXPORTERS

I. Disappearance

1. $QDD = 16.9725 - \underset{(.35)}{.2942PWHEDWHO} + \underset{(1.45)}{14.2587POP} + \underset{(.08)}{.239YI}$

$R^2 = .80$ S = 56.19 Data = 1960-71

II. Production

1. $QS = -2505.1109 + \underset{(.85)}{.5277PWHESWHO} + \underset{(14.06)}{54.571T}$

$R^2 = .96$ S = 45.85 Data = 1960-71

III. Price Relationships

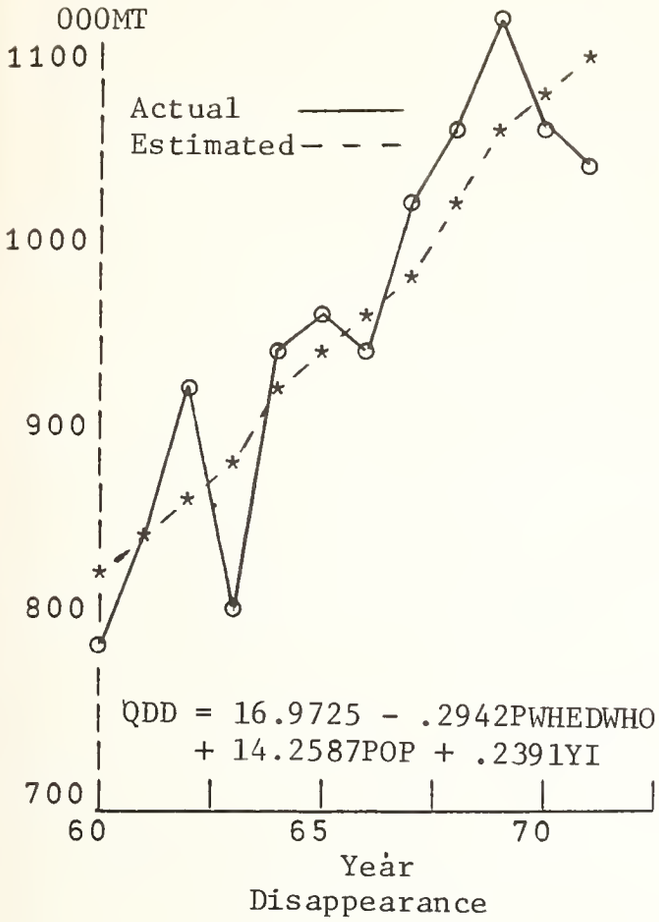
1. $PWHEDWHO = 46.8755 + \underset{(1.63)}{.4399PTHAEXL} + \underset{(.45)}{.8196T}$

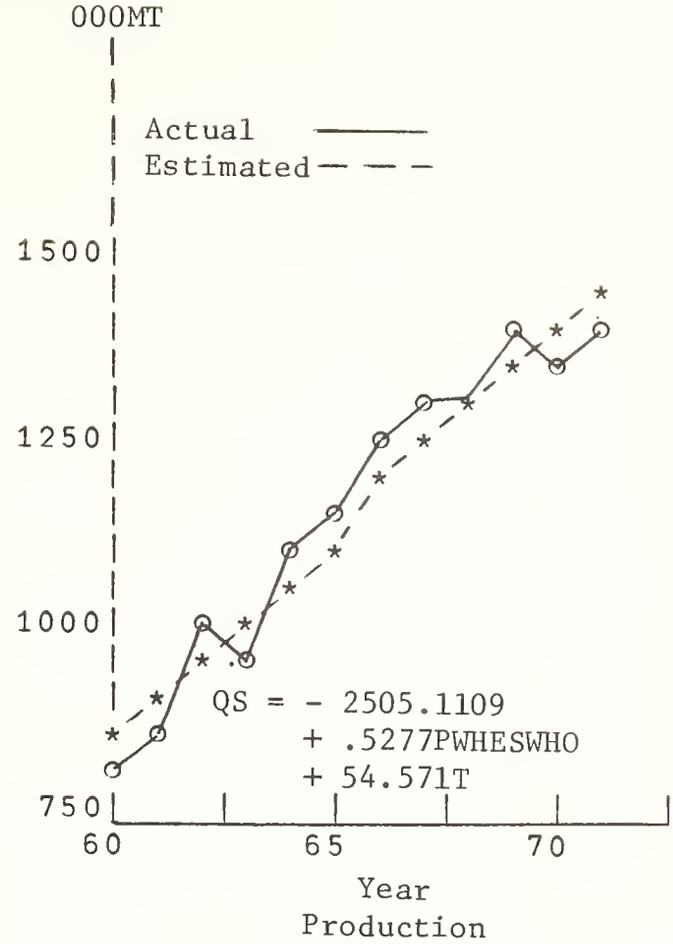
$R^2 = .25$ S = 21.55 Data = 1960-71

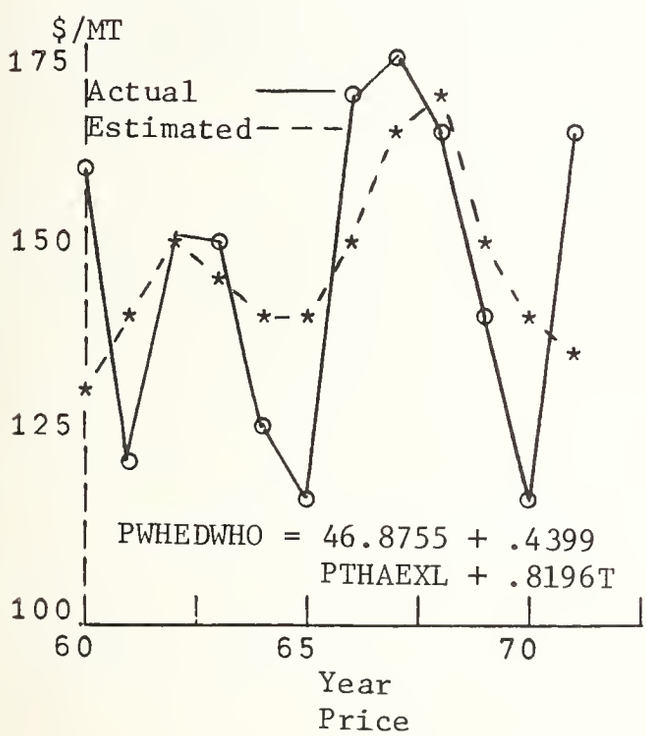
2. PWHESWHO = PWHEDWHO

Where:

QDD	=	Domestic disappearance in thousand metric tons milled rice
QS	=	Domestic production in thousand metric tons milled rice
PWHEDWHO	=	Low quality wholesale price, U.S. dollars per metric ton
PWHESWHO	=	Low quality wholesale price, U.S. dollars per metric ton
PTHAEXL	=	Low quality export price, Thailand, U.S. dollars per metric ton
YI	=	Per capita income index
T	=	Years, 1960 = 60
POP	=	Midyear population in millions







WESTERN HEMISPHERE EXPORTERS

I. Disappearance

1. $QDD = [13.0262 - \underset{(1.24)}{.0183POWHDEXP} + \underset{(.46)}{.0094YPCI}]POP$

$R^2 = .15$ S = 1.17 Data = 1960-71

II. Production

1. $QS = - 943.1165 + \underset{(3.16)}{1.9603POWHSFAR} + \underset{(5.53)}{1.1064YIELD}$

$R^2 = .88$ S = 61.99 Data = 1960-71

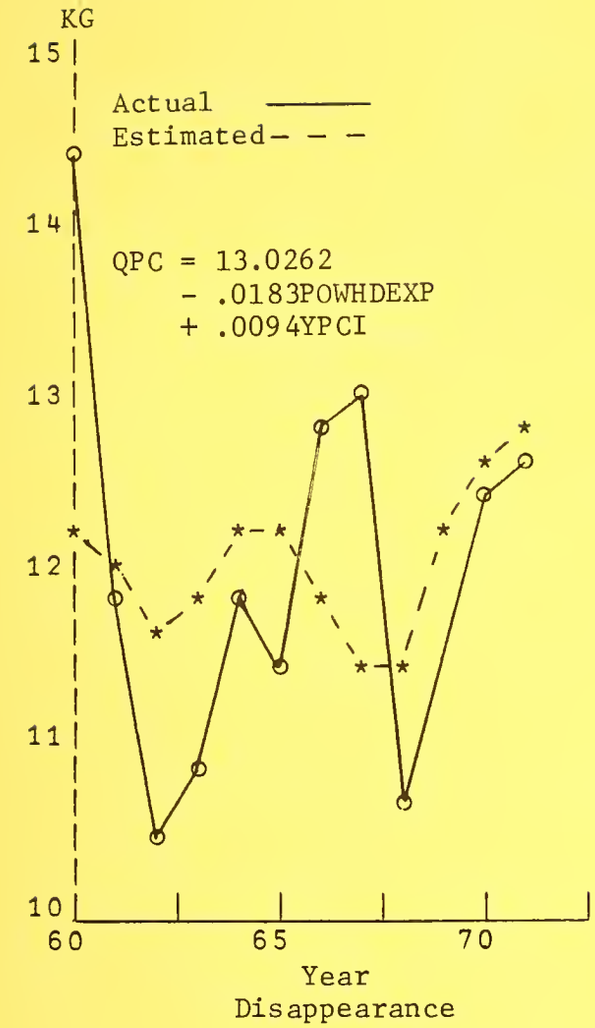
III. Price Relationships

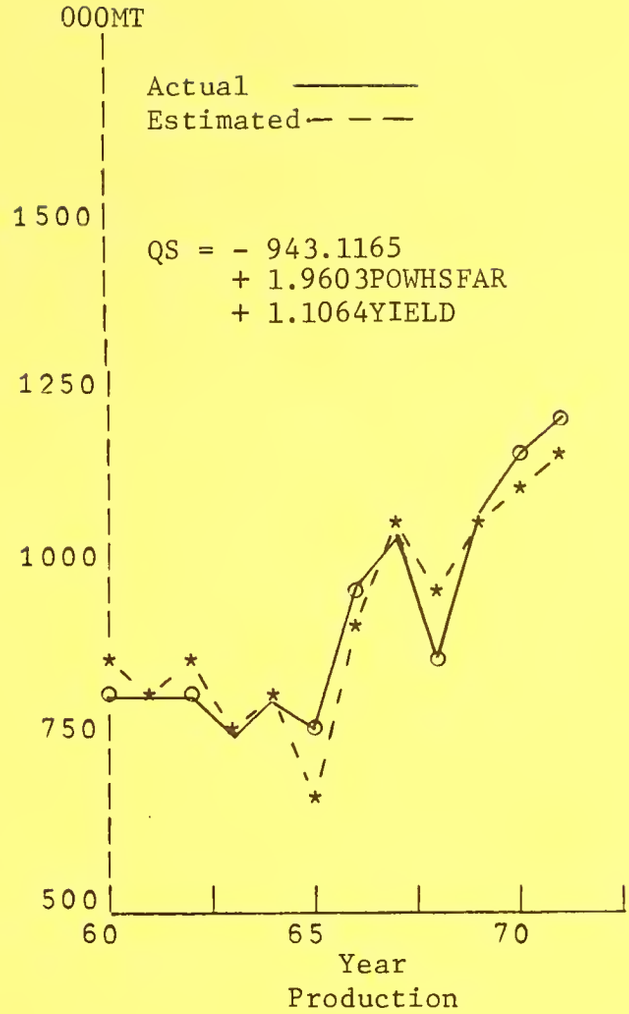
1. POWHDEXP = PTHAEXL

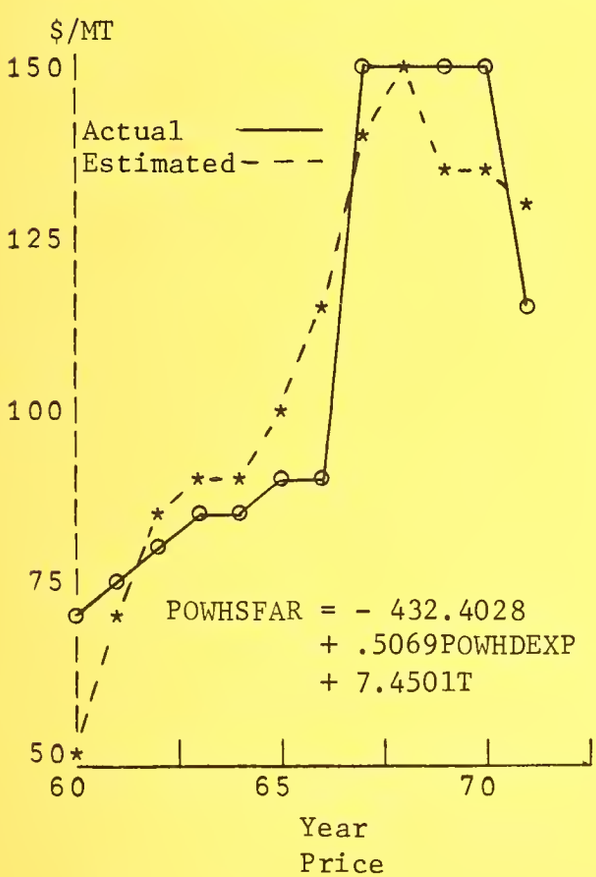
2. $POWHSFAR = - 432.4028 + \underset{(2.67)}{.5069POWHDEXP} + \underset{(5.88)}{7.4501T}$

$R^2 = .83$ S = 15.13 Data = 1960-71

Where:
- QDD = Domestic disappearance in thousand metric tons milled rice
- QS = Domestic production in thousand metric tons milled rice
- POWHDEXP = Low quality export price, U.S. dollars per metric ton
- POWHSFAR = Low quality farm price, U.S. dollars per metric ton
- PTHAEXL = Low quality export price, Thailand, U.S. dollars per metric ton
- YPCI = Income per capita index, 1967-69 = 100
- YIELD = Yield per hectare in kilograms
- T = Years, 1960 = 60







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